9th Edition of World

Nanotechnology Conference

7th Edition of International Conference on

Materials Science and Engineering

28-30

Oct, 2024

Online Event

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OCT

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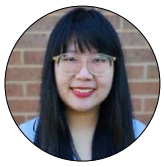

Wariya Nirachonkul,
Chiang Mai University,
Thailand

Zakia Hammou,
University of Science and Technology of Oran, Algeria

Thank You All...

Welcome Message

Thomas J. Webster

Interstellar Therapeutics, United States

Dear Conference Attendees,

It gives me great pleasure to welcome you to MAT-2024. At a time when conventional conferences seem to be recycling old presentations with old ideas, I welcome you to a breath of fresh air. I know because I have been attending conferences for close to 30 years and I have seen it all. Conferences which stimulate thinking and conferences which inhibit thinking. People who are optimistic about research and people who just want you to talk about their research. Conferences which help you develop new solutions to old problems and conferences which just create problems.

At MAT-2024 we will represent the positive conference. A conference with a mixture of new researchers from all over the world with creative ideas, ideas we undoubtedly have not heard of before to solve our toughest material science problems for energy, medicine, environmental and other pressing societal problems. We will form new collaborations to provide this breath of fresh air we all so badly need to solve some of our more difficult material science questions.

It indeed was this breath of fresh air that a good conference can provide (if done correctly) that stimulated me to create nanotextured spinal medical devices that are currently in over 30,000 patients, with no documented cases of failure (the industry standard is 5 – 10% failure). It is this breath of fresh air that helped my research team develop a molecule to passivate SARS-CoV-2, the virus that causes COVID. It is this breath of fresh air that helped me create implantable sensors that can detect bacteria on an implant and respond to kill that bacteria on-demand and wirelessly before it becomes an infection. It is this breath of fresh air that is helping me incorporate artificial intelligence (AI) into improved material design for energy, medicine, and environmental applications.

So, come attend MAT-2024. Make new colleagues. Hear new research. Get stimulated. Take that breath of fresh of air.

Welcome Message

Robert Buenker

University of Wuppertal, Germany

Dear participants of the congress, it is my honor and pleasure to write a few welcoming remarks. Obesity is a global problem that affects both developing and developed countries, it has an impact not only on the current state of health of the population from children to the elderly, but also significantly affects their quality of life and at the same time has a significant negative economic impact. Controlling obesity is not only a medical problem, but for its effective management, experts from practically all fields affecting modern man must work together. Therefore, its systematic treatment is the goal of scientific teams around the world. The exchange of experience with obesity management gained by specialists in different countries of the world with different solution conditions, and especially the possibility of direct contact of scientific capacities, can contribute significantly to the effective solution of this problem. This opens up new opportunities to successfully solution this global pandemic.

Welcome Message

Professor Paulo De Morais

Catholic University of Brasilia, Brazil

It is my pleasure to cordially invite you all to join the to the "9th Edition of World Nanotechnology Conference (Nanotechnology2024)", which will be held in virtually during October 28-30, 2024.

The selected theme of Nanotechnology2024 is: "Future Horizons: Emerging Trends in Nanotechnology". The conference will offer the ideal environment for scientists, academics, industrial engineers and students working on the cross-disciplinary area of nanotechnology to present and discuss recent ideas, new trends, and achievements. Among others, the conference covers Nanoscience, Nanomedicine & Nano Sensors, Nanobiotechnology & Nanosafety, Nanochemistry, Green Nanotechnology, Nanocarbon Materials, Nanobiomaterials, Nanotoxicology, Nanoelectronics and Nanophotonics, Nanocharacterization & Nanomanufacturing, and Forensic Nanotechnology.

Nanotechnology2024 will be a three-day event, gathering together key players of the Global Nanotechnology Community and related areas. The event is planned to attract delegates from all over the World aiming at sharing, exchanging and exploring new opportunities of nanostructured materials and their technological applications.

We look forward to seeing you at Nanotechnology2024 virtually.

Welcome Message

Rafal Kozubski

Jagiellonian University in Krakow, Poland

The contemporary development of technologies that shape the standard of everyday life is driven to a very large extent by the discovery and use of new materials. Although people now have extremely wide opportunities to expand the scale of purely technical testing of materials and search for optimal solutions by “trial and error”, real progress and innovation require understanding the properties of materials as a consequence of physical laws at an elementary level. This is achieved by reaching for natural sciences, which are constantly based on relating all theoretical concepts to an experiment, which, however, is often extremely expensive and time-consuming. The dynamic development of computational techniques helps here by making it possible to supplement purely experimental research with simulations conducted on the atomic scale. In this way, emerging theories can be tested by conducting the so-called computer experiments, which often allow us to analyze the course of phenomena occurring in materials on the atomic scale that are experimentally inaccessible but determine the technological properties.

Welcome Message

Raman Singh

Monash University-Clayton Campus, Australia

"It is my great pleasure to extend a warm welcome, on behalf of the organisers of 9th Edition of World Nanotechnology Conference. Nanomaterials and nanotechnology are foremost crucial for any technological development, and the conference is actively pursuing engagement of scientists, researchers, nanotechnologists, chemists, physicists, healthcare professionals, pharmacists, clinicians, practitioners, industry leaders, and educators in the cutting edge topics of nanomaterials and nanotechnology, namely, graphene, alternative energy, hydrogels, biomolecules, artificial intelligence, additive manufacturing, high entropy alloys, biological molecules/systems, corrosion, electronics, polymers, and so on. The organisers deserve appreciation of the nanomaterials and nanotechnology community, and the best way will be to ensure great participation."

ABOUT
MAGNUS GROUP

Magnus Group, a distinguished scientific event organizer, has been at the forefront of fostering knowledge exchange and collaboration since its inception in 2015. With a steadfast commitment to the ethos of "Share, Receive, Grow," Magnus Group has successfully organized over 200 conferences spanning diverse fields, including Healthcare, Medical, Pharmaceutics, Chemistry, Nursing, Agriculture, and Plant Sciences.

The core philosophy of Magnus Group revolves around creating dynamic platforms that facilitate the exchange of cutting-edge research, insights, and innovations within the global scientific community. By bringing together experts, scholars, and professionals from various disciplines, Magnus Group cultivates an environment conducive to intellectual discourse, networking, and interdisciplinary collaboration.

Magnus Group's unwavering dedication to organizing impactful scientific events has positioned it as a key player in the global scientific community. By adhering to the motto of "Share, Receive, Grow," Magnus Group continues to contribute significantly to the advancement of knowledge and the development of innovative solutions in various scientific domains.

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KEYNOTE PRESENTATIONS

Current and future of red and black phosphorus nanomaterials

A summary of some optoelectronic applications of red and black phosphorus nanomaterials. The synthesis, characterization, stability improvement of the materials will also be discussed.

Hai-Feng Ji

Department of Chemistry, Drexel University, Philadelphia PA 19104, USA

Biography

Dr. Hai-Feng (Frank) Ji is current a professor of Department of Chemistry, Drexel university. His research interests focus on MEMS devices, nanomaterials for energy and environmental applications, drug discovery, nanopillars and phosphene for energy applications, and surface chemistry. He is currently a co-author of 220 peer-viewed journal articles and book chapters. He has an H-index of 43. He is an editorial board member of several chemistry journals.

Porphyrin layers at metal-electrolyte interfaces monitored by EC-STM and CV

B. Mądry[1], I. Morawski[1], T. Kosmala[1], R. Wasielewski[1], K. Wandelt[1,2], M. Nowicki[1]*

[1]Institute of Experimental Physics, University of Wroclaw, pl. M. Borna 9, 50-204 Wroclaw, Poland

[2]Institute of Physical and Theoretical Chemistry, University of Bonn, Wegelerstr. 12, 53115 Bonn, Germany

Porphyrin derivatives play a crutial role in biochemical processes like chlorophyll in the photosynthesis of plants, heme of red blood cells in the transport and storage of oxygen, and vitamin B-12 in the metabolism of creatures. Porphyrin derivatives are materials for electrocatalysts, drug production and cancer chemotherapy, sensors, solar cells, optoelectronic, data storage devices, and molecular electronics. We used Electrochemical Scanning Tunneling Microscopy (EC-STM) and Cyclic Voltammetry (CV) to investigate these organic compounds at solid-liquid interfaces. In particular the coadsorption of porphyrin molecules (TMPyP: Tetra (N-methyl-4-pyridyl)-porphyrin), sulfate and copper on Au (111), as well as iodine on Au(111), Au(110), and Au(100) was investigated with atomic resolution. With decreasing electrode potential the following sequence of phases was found: (3×7) R19.1° $-SO_4^{2-}$ on Au(111)-(1×1), disordered SO_4^{2-}-layer on Au(111)-(1×1), (3× 3)R30° coadsorption structure of 2/3 ML Cu and 1/3 ML SO_4, 1 ML Cu covered by a layer of mobile SO_4^{2-}, a coadsorption layer of disordered porphyrin molecules and still mobile SO_4^{2}, overpotentially deposited Cu-multilayers terminated by the Moiré-type (3× 7)R19.1° $-SO_4^{2-}$ structure and covered by a dense layer of flat lying TMPyP molecules showing a growing square and hexagonally ordered arrangement, and at even more negative potentials and low Cu concentrations in the solution a pseudomorphic Cu-monolayer covered by a (3×7)R19.1° $-SO_4^{2-}$ layer and ordered porphyrin layer on top. The formation of CuTMPyP-metalloporphyrins and the Cu-Au alloy at multilayer copper deposits is suggested. The growth of long-range ordered two dimensional porphyrin layer was found on iodine precovered Au(111) and Au(100). STM images reveal planar adsorption of molecules. High resolution images reflect ligands and empty molecular cores. Tunneling at different bias voltages enabled to reveal the orientation of porphyrins with respect to the crystalline electrode.

Biography

Prof. Dr. Marek Nowicki studied Physics at the University of Wroclaw, Poland and graduated as MS in 1992. He joined the group of Prof. S. Mroz at the Institute of Experimental Physics of the University of Wroclaw. He received his PhD in 1996 at the same institution. From 1998 till 2002 he worked as an Alexander von Humboldt Fellow and postdoc at Forschungszentrum Jülich GmbH, Germany (Prof. H.P. Bonzel). Then he joined the Department of Chemical Physics of the FHI-MPG in Berlin, Germany (prof. H.J. Freund). In 2006 he received habilitation and in 2016 professorship at the University of Wroclaw.

Audience Take Away Notes

- Application of Electrochemical Scanning Tunneling Microscopy (EC-STM) and cyclic voltammetry (CV) in investigations of solid-liquid interfaces
- Potential induced assembly of organic and inorganic molecules on crystalline electrodes in solutions
- Determination of adsorption/desorption and/or oxidation/reduction processes at solid-liquid interfaces
- Identification of surface structures with atomic resolution
- Applications of porphyrins as two dimensional materials in future technology

Tailoring subwavelength scale electromagnetic field patterns with the help of nanoparticles

Resonant light scattering by nanoparticles provides a unique opportunity to concentrate a high-amplitude electromagnetic field in a subwavelength area of space as well as to tailor and control its pattern. In addition to purely academic interest, this is extremely important for numerous applications ranging from medicine and biology to telecommunication and data processing. Despite more than a hundred years of extensive study, the problem is still far from completion. A review of new results in this field is presented in this contribution. In many cases, despite the smallness of the scattering particles, their light scattering has very little in common with the conventional Rayleigh case. New, counterintuitive effects, especially those related to violating the quasi-static description of the scattering occurring at the action of (ultra)short laser pulses, are pointed out, inspected, discussed, and classified.

Audience Take Away Notes

- The talk gives new insights into the old problem of light scattering by particles. The results may be used as grounds for developing new nanotechnologies and metamaterials
- The discussed results are interesting both from an academic viewpoint and for practical applications
- Though the discussed results are not directly related to technological processes, they open the door to new technologies

Michael I. Tribelsky

Faculty of Physics, Lomonosov Moscow State University, Moscow, Russia

Biography

Prof. Tribelsky received his MS from Lomonosov Moscow State University in 1973, a PhD from Moscow Institute of Physics and Technology in 1976, and a Dr. of Sci. (habilitation) from Landau Institute in 1985. He received numerous national and international awards: Leninsky Komsomol Prize (1979); COE Professorship, the University of Tokyo (2006, 2008) and Kyushu University (2007), Japan; Honorary PhD, Yamaguchi University, Japan (2016), etc. Presently, his interest lies in subwavelength optics. He is the author of several books, book chapters, review articles, and more than 100 research papers. See https://polly.phys.msu.ru/en/labs/Tribelsky/ for more details.

Logistic-modified mathematical model for tumor growth treated with nanosized cargo delivery system

The logistic mathematical approach has been successfully employed to describe an impressive amount of data relating the tumor Volume (V) versus time (t). Shortly, the logistic model accounts for the balance between positive Malthusian-like fractional growth rate and terms describing negative growth rates emerging from different mechanisms. However, this approach does not account for tumor regression due to a successful treatment protocol. In this regard the modified logistic model, is here in presented to describe the temporal tumor evolution outside the standard logistic model and includes a time-dependent exponential prefactor to the tumor volume shrinking rate. This exponential prefactor is phenomenologically introduced aiming to describe the temporal effect of an external intervention, leading to an extra tumor volume shrinking, being represented for instance either by the use of a therapy or by an antitumor agent administration, or by the combination of both. The talk will present experimental data regarding tumor volume growth evolution in mice bearing solid mammary tumor subjected to different treatments. The data recorded from the first protocol are successfully fitted using the standard logistic model. However, following a different therapy, the tumor volume growth reaches a maximum value, following its shrinking down to complete remission. The latter result is successfully described by the modified logistic model. Importantly, quantitative evaluation of in vivo assays aligns with the global initiative of minimizing the use of animals while helping to plan comprehensively future experiments.

Audience Take Away Notes

- The audience involved with cancer research will be able to use the material presented in the talk while performing in vivo experiments
- The material presented in the talk will help the audience in moving forward from qualitative to quantitative analysis
- The logistic mathematical approach is quite general and can be applied in many areas of experimental research

Paulo C. De Morais

Catholic University of Brasília, Brasilia, DF, Brazil

University of Brasília, Brasilia, DF, Brazil

Biography

Professor Paulo César De Morais, PhD, was full Professor of Physics at the University of Brasilia (UnB)–Brazil up to 2013. Appointed as UnB's (Brazil) Emeritus Professor (2014); Visiting Professor at the Huazhong University of Science and Technology (HUST)–China (2012-015); Distinguished Professor at the Anhui University (AHU)–China (2016-2019); Full Professor at the Catholic University of Brasília (CUB)–Brazil (2018); CNPq-1A Research Fellow since 2010; 2007 Master Research Prize from UnB. He held two-years (1987-1988) post-doc position with Bell Communications Research, New Jersey–USA and received his Doctoral degree in Solid State Physics (1986) from the Federal University of Minas Gerais (UFMG)–Brazil. With more than 12,000 citations, He has published about 500 papers (Web of Science) and more than 15 patents.

Atomistic simulation of chemical ordering phenomena in nanostructured intermetallics

Vacancy-mediated chemical ordering phenomena were studied by means of Monte Carlo (MC) simulations in nanostructured B2-ordering NiAl and L10-ordering FePt. The (100)-oriented NiAl films were modeled with an Ising-type Hamiltonian with pair-interaction energy parameters yielding the effect of "triple-defect disordering". While the Semi Grand Canonical MC (SGCMC) simulations provided equilibrium defect concentration and configuration in the films, the Kinetic MC (KMC) ones enabled modelling of the sample relaxations towards equilibrium configurations. Specific effects of free surfaces on both the defect concentration and ordering kinetics were revealed.

MC simulations of free-surface-induced L10 chemical long-range ordering phenomena in nanolayers, nanowires and cubic nanoparticles of FePt modelled with nearest-neighbor and nextnearest-neighbor interatomic pair interactions deduced from ab initio calculations were focused on the surface-induced nucleation and growth of domains of particular L10 variants. The phenomenon is of great technological importance. Due to the specific competition between the three kinds of (100)-type free surfaces, the initial c-L10 variant long-range order appeared the most stable in the cubic nanoparticles.

Keywords: Nanostructured Intermetallics; Chemical Ordering; Monte Carlo Simulations.

R. Kozubski

Faculty of Physics, Astronomy and Applied Computer Science, Jagiellonian University in Krakow, Lojasiewicza 11, 30-348 Krakow, Poland

Biography

Prof. Rafal Kozubski completed his Ph.D. and D.Sc. at the Jagiellonian University in Kraków. He was a post-doc at the Strasbourg Institute of Physics and Chemistry of Materials (IPCMS), France, an academic visitor in the Institute for Applied Physics, Swiss Federal Institute of Technology, Zurich, Switzerland and a Lise-Meitner Fellow at the Vienna University, Austria. His international experience includes also an International Fellowship at the Queen's University in Belfast, a visiting professorship at the University of Strasbourg, France and the Honorary Professorship at the University of Newcastle, Australia. He published over 100 scientific papers in international reviewed journals and is an author of over 150 communications on international conferences.

Circumventing challenges in developing CVD graphene coating on mild steel: A disruptive approach to remarkable/ durable corrosion resistance

The talk will discuss the challenges in developing corrosion resistant graphene coating on most common engineering alloys, such as mild steel, and present recent results demonstrating circumvention of these challenges. In spite of traditional approaches of corrosion mitigation (e.g., use of corrosion resistance alloys such as stainless steels and coatings), loss of infrastructure due to corrosion continues to be a vexing problem. So, it is technologically as well as commercially attractive to explore disruptive approaches for durable corrosion resistance. Graphene has triggered unprecedented research excitement for its exceptional characteristics. The most relevant properties of graphene as corrosion resistance barrier are its remarkable chemical inertness, impermeability and toughness, i.e., the requirements of an ideal surface barrier coating for corrosion resistance. However, the extent of corrosion resistance has been found to vary considerably in different studies. The author's group has demonstrated an ultra-thin graphene coating to improve corrosion resistance of copper by two orders of magnitude in an aggressive chloride solution (i.e., similar to sea-water). In contrast, other reports suggest the graphene coating to actually enhance corrosion rate of copper, particularly during extended exposures. Authors group has investigated the reasons for such contrast in corrosion resistance due to graphene coating as reported by different researchers. On the basis of the findings, author's group has succeeded in demonstration of remarkable and durable corrosion resistance of mild steel as result of development of suitable graphene coating.

Audience Take Away Notes

- Graphene as a wonder material
- Extraordinary and unique characteristics of graphene as corrosion-resistance coatings
- Challenges in developing pristine graphene coatings on steels (for corrosion resistance)
- Successful circumvention through innovative surface modification
- Demonstration of graphene-coated mild steel providing remarkable (possibly, everlasting) corrosion resistance

Raman Singh

Department of Mechanical & Aerospace Engineering, AND Department of Chemical & Biological Engineering, Monash University, Australia

Biography

Professor Raman Singh's primary research interests are in the relationship of Nano/ microstructure and Environment-assisted degradation and fracture of metallic and composite materials, and Nanotechnology for Advanced Mitigation of such Degradations. He has worked extensively on advanced materials (e.g., graphene) for corrosion mitigation, stress corrosion cracking, and corrosion-mitigation. He is a senior professor at Monash University, Australia. He is/was a Guest Professor at ETH Zurich, Switzerland (2020, 2023, 2024), US Naval Research Lab, Indian Institute of Science, and University of Connecticut. Prof Singh's professional distinctions and recognitions include: Guest Professor of ETH Zurich, Editor of a book on Cracking of Welds (CRC Press), Lead Editor of a book on Non-destructive Evaluation of Corrosion (Wiley), Editor-in-Chief of an Elsevier and two MDPI journals, leader/chairperson of a few international conferences and numerous plenary/keynote lectures at international conferences, over 275 peer-reviewed international journal publications and 15 book chapter, and several competitive research grants. He has supervised 60 PhD students.

The failure of both Einstein's space-time theory and his equivalence principle and their resolution by the uniform scaling method

The Lorentz Transformation (LT) makes three predictions which are not consistent with one another: Lorentz-FitzGerald Length Contraction (FLC), Time Dilation (TD) and light-speed equality for observers in relative motion to one another. The LT also stands in violation of the Law of Causality because it fails to recognize that inertial clocks can never change their rate spontaneously. Einstein's Light-Speed Postulate (LSP) is shown to be unviable by considering a case in which a light source passes by a stationary observer at the same time that it emits a light pulse in the same direction. It is found that, in contradiction to the LSP, that the classical velocity (Galilean) Transformation (GVT) is applicable when two observers in relative motion deduce the speed of a light wave.

The Newton-Voigt Transformation (NVT) is consistent with the Law of Causality because it assumes space and time do not mix. The NVT is nonetheless consistent with the Relativistic Velocity Transformation (RVT) and also with Einstein's mass-energy equivalence relation E=mc2. The ratio Q of clock rates for two inertial rest frames S and S' is required input for the NVT. Experimental data obey the Universal Time-dilation Law (UTDL) which states that the measured time Δt obtained by a inertial clock for a given event is inversely proportional to □(v)=(1-v2c-2)-0.5v, where v is the speed of the clock relative to a specific rest frame referred to as the objective rest frame ORS. The value of Q when the clock of the observer in at rest in S while that of another observer is at rest in the object's rest frame S' is obtained from the UTDL as the ratio □(v')/□(v). The Uniform Scaling method considers Q to be a conversion factor between the units of time in the two rest frames. It is found that the conversion factors for all other physical properties are integral multiples of Q. Kinetic scaling of the properties insures that the laws of physics are the same in each inertial frame, as required by the RP. It is also pointed out that Einstein's Equivalence Principle (EP) fails to deduce the experimental fact that the wavelength of light is invariant to changes in gravitational potential. The Universal Scaling method uses a set of conversion factors for the effects of gravity that is analogous to those for kinetic scaling.

Robert Buenker

University of Wuppertal, Germany

Biography

Robert J. Buenker born to Mr. and Mrs. Joseph F. Buenker in Dubuque, Iowa.He received B.S. Degree (Maxima Cum Laude) in Mathematics and Chemistry from Loras College, Dubuque, Iowa and Ph.D. Degree in Chemistry from Princeton University, Princeton, New Jersey. He worked as Assistant Professor of Chemistry, University of Nebraska, Lincoln, Nebraska. Associate Professor of Chemistry, University of Nebraska, Lincoln, Nebraska. Professor of Chemistry, University of Nebraska, Lincoln, Nebraska Wissenschaftlicher Rat und Professor, Universität Bonn, Germany. Professor of Theoretical Chemistry, Bergische Universität-Gesamthochschule, Wuppertal, Germany. Adjunct Professor, Department of Chemistry, North Carolina State University, Raleigh, NC, USA. Emeritus Professor of Theoretical Chemistry, Bergische-Universität, Wuppertal, Germany. Adjunct Professor, Department of Physics, University of Georgia, Athens, GA, USA. Awards: Senior U.S.Scientist Award of the Humboldt Foundation for research and teaching at the University of Bonn, Germany.

30,000 nanotextured implants in humans with no failures (and no drugs)

Implant infection is rising with the U.S. Centers for Disease Control predicting one person every three seconds will die from a bacteria infection by 2050. Nanomedicine is the use of nanomaterials to improve disease prevention, detection, and treatment which has resulted in hundreds of FDA approved medical products. While nanomedicine has been around for several decades, new technological advances are pushing its boundaries. For example, this presentation will provide an over 25 year journey of commercializing nanotexture implants now in over 30,000 patients to date showing no signs of failure. Current implants face a failure rate of 5 – 10% and sometimes as high as 60% for cancer patients. Further, Artificial Intelligence (AI) has revolutionized numerous industries to date. However, its use in nanomedicine has remained few and far between. One area that AI has significantly improved nanomedicine is through implantable sensors. This talk will present research in which implantable sensors, using AI, can learn from patient's response to implants and predict future outcomes. Such implantable sensors not only incorporate AI, but also communicate to a handheld device, and can reverse AI predicted adverse events. Examples will be given in which AI implantable sensors have been used in medicine to inhibit implant infection and promote prolonged tissue growth. In vitro and in vivo experiments will be provided that demonstrate how AI can be used towards our advantage in nanomedicine, especially implantable sensors. Lastly, this talk will summarize recent advances in nanomedicine to both help human health and save the environment.

Thomas J. Webster

School of Health Sciences and Biomedical Engineering, Hebei University of Technology, Tianjin, China; School of Engineering, Saveetha University, Chennai, India; Division of Pre-College and Undergraduate Studies, Brown University, Providence, RI USA

Biography

Thomas J. Webster's (H index: 128) degrees are in chemical engineering from the University of Pittsburgh (B.S., 1995; USA) and in biomedical engineering from RPI (Ph.D., 2000; USA). He has formed over a dozen companies who have numerous FDA approved medical products currently improving human health in over 30,000 patients. His technology is also being used in commercial products to improve sustainability and renewable energy. He is currently helping those companies and serves as a professor at Brown University, Saveetha University, Hebei University of Technology, UFPI, and others. Dr. Webster has numerous awards including: 2020, World Top 2% Scientist by Citations (PLOS); 2020, SCOPUS Highly Cited Research (Top 1% Materials Science and Mixed Fields); 2021, Clarivate Top 0.1% Most Influential Researchers (Pharmacology and Toxicology); 2022, Best Materials Science Scientist by Citations (Research.com); and is a fellow of over 8 societies. Prof. Webster is a former President of the U.S. Society for Biomaterials and has over 1,350 publications to his credit with over 66,000 citations. He was recently nominated for the Nobel Prize in Chemistry. Prof. Webster also recently formed a fund to support Nigerian student research opportunities in the U.S.

Introducing picotechnology: An exciting extension of nanotechnology

Nanotechnology, or the control of matter at the atomic scale, has changed material science as we know it. Nanotechnology was once thought of as science fiction when over 23 years ago, the U.S. National Nanotechnology Initiative was announced by President Clinton. Since then nanotechnology has resulted in $42 billion in new product revenue in 2017 alone and has generated over 50 products approved by the FDA, including recent COVID vaccines. Picotechnology is a natural extension of nanotechnology and is defined as the control of matter at the picometer scale (10-12 m or one trillionth of a meter). This is the size scale of sub-atomic units, such as electrons, protons and neutrons– the building blocks of atoms which dictate the type of element on the periodic table, their reactivity, atomic properties, and what type of bonds (if any) they form with other atoms. Changes in sub-atomic events, such as the number of electrons in the outer orbital of an atom, are critical for how elements bond to one another and, thus, govern all material properties (including mechanical, catalytic, surface, electrical, magnetic, piezoelectric, biological, and more). Research in picotechnology has received a boost recently due to the Nobel Prize in Physics awarded for the discovery of how to visualize sub-atomic particles. This invited talk will present for the first time the field of picotechnology providing highlights of how picotechnology is destined to revolutionizing material science.

Audience Take Away Notes

- Regarding picotechnology
- Controlling of sub-atomic particles changes material properties
- Commercial products can be developed out of picotechnology

Thomas J. Webster, Ph.D.

Interstellar Therapeutics, Mansfield, MA USA

Biography

Thomas J. Webster's (H index: 121; Google Scholar) degrees are in chemical engineering from the University of Pittsburgh (B.S., 1995; USA) and in biomedical engineering from RPI (Ph.D., 2000; USA). He has served as a professor at Purdue (2000-2005), Brown (2005-2012), and Northeastern (2012-2021; serving as Chemical Engineering Department Chair from 2012-2019) Universities and has formed over a dozen companies who have numerous FDA approved medical products currently improving human health in over 20,000 patients. He is currently helping those companies and serves as a professor at Brown University, Saveetha University, Vellore Institute of Technology, UFPI, and others. Dr. Webster has numerous awards including: 2020, World Top 2% Scientist by Citations (PLOS); 2020, SCOPUS Highly Cited Research (Top 1% Materials Science and Mixed Fields); 2021, Clarivate Top 0.1% Most Influential Researchers (Pharmacology and Toxicology); 2022, Best Materials Science Scientist by Citations (Research.com); and is a fellow of over 8 societies. Prof. Webster is a former President of the U.S. Society For Biomaterials and has over 1,350 publications to his credit with over 55,000 citations. He was recently nominated for the Nobel Prize in Chemistry.

Color control of electrochromes by structural modification

Materials that can charge their color on-demand have been used in a wide range of applications. While most uses rely on the acuity of the materials in the visible region, the invisible changes occurring in the NIR offer environmental benefits. This is the case when the color changing materials are integrated into smart windows. By filtering NIR sunlight during light intense periods, the cooling loads of buildings can be reduced. This contrast with allowing radiant heat to enter buildings for heating during cool periods. Reversibly filtering the light that can pass through windows has the economic benefit of reducing the cooling/heating loads of buildings. Given the electricity that sustains building operations is often produced from environmental deleterious sources, reducing energy consumption for building cooling/heating also has ecological benefits.

Targeted properties of smart windows are: reversible colors change in both the visible and the NIR regions; consistent coloration/bleaching over extended cycles of color switching; and reversible oxidation/reduction. The effect of structural modification on the color switching materials will be presented. Of importance, the NIR absorption and the bleaching time contingent on the type of electronic groups on the molecular electrochromes will be discussed towards achieving the ideal color switching material. Properties of the materials assessed in solution and then in operating test devices will be presented towards achieving high performance smart windows.

Mohan Anthony Raj, Will Skene*

Department of Chemistry,
Université de Montréal,
Montréal, QC, Canada

Biography

The Skene research group focuses on using sustainable practices for developing sustainable devices.
The team is interested in establishing accurate structure-property relationships of conjugated organic materials.
Knowledge acquired from such studies is used in the rational design of materials whose properties can be adjusted to meet the requirements for a given application. The group also evaluates the performance of materials in solution, thin films and devices for improving the overall performance of devices.

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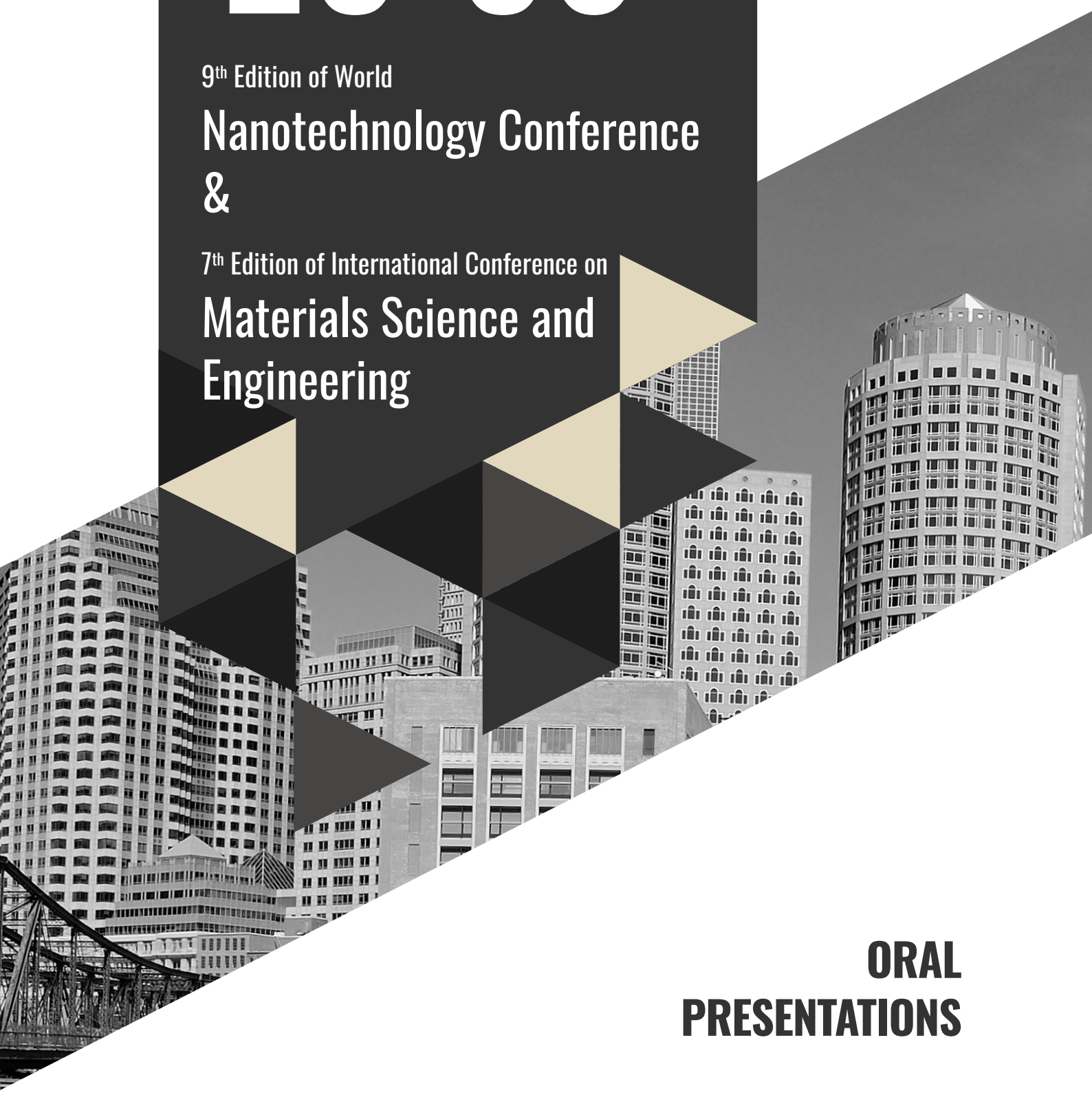

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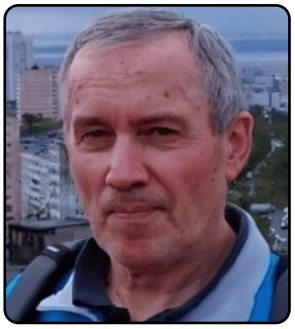

I.M. Chernev[1], Eu.V. Subbotin[1], A.V. Gerasimenko[2], A.Yu. Ustinov[2], A.G. Kozlov[3], M. V. Poliakov[4,5], L.S. Volkova[4], A.A. Dudin[4,1] Alexander S. Gouralnik[1*]

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[2]Institute of Chemistry FEB RAS, Vladivostok, Russia
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Make experiments more efficient: Two simple and powerful approaches. Mg2si growth for photovoltaic and thermoelectric applications

Film growth and surface/interface processes are crucial in many modern technologies, including Si-based microelectronics. We introduce two original approaches effective in film synthesis and investigations.

The narrow band silicide Mg2Si attracts attention of researchers because it has good perspectives for applications in solar cells and thermoelectric elements, consists of ecologic, abundant and rather cheap components. However, the synthesis of Mg2Si films on Si surface is problematic: at low T Mg does not intermix with Si but At High Temperatures (HT) the deposited Mg re-evaporates without film formation. Thus, Mg/Si is a good model system for demonstration of advantages of our approaches. Basing on the analysis of the deposition kinetics, we explain how and why Mg2Si can be grown on Si at HT by ultra-fast deposition. The exothermic reaction process takes ~0.1–100 s., the process similar to Self-Propagating High-temperature Synthesis can be easily recorded with a phone camera. The obtained films have the best crystal quality and excellent electrophysical parameters.

To study different physical and chemical processes on surfaces/interfaces (film growth, reactions, phase transformations etc), multiple experiments are usually carried out; they are time and resource consuming. If the sample has a wedge-shaped temperature distribution on the surface, different processes can be studied in the whole T range in a single experiment. Thus, one experiment can be enough to obtain the dependences of process parameters on T; the exact value of the optimal T can be found immediately and directly. We demonstrate how the T ranges of ~ 600–850 K can be obtained due to the Peltier effect in low resistivity Si samples. Using this approach, the number of experiments necessary for achieving the result can be radically reduced. Thus, the efficiency of experimental work can be significantly increased.

Audience Take Away Notes

- The both presented experimental approaches are simple and can be easily reproduced in the any laboratory
- The described techniques allow to enhance the efficiency of studying many T-dependent processes (diffusion, reactions, phase transformations etc) on different surfaces or interfaces
- The scientists using these methods will be able to obtain more precise results, spending less resources, within less time

Biography

Alexander S. Gouralnik was born in 1952 in Samarkand (Uzbekistan). He is graduated from the Leningrad (now Sankt-Petersburg) State University, Physics Departement, in 1976. Work experience: 1976–1979: Artificial Intelligence Dpt., Lab. of 3D Microelectronics, Institute of Automation and Control Processes (IACP FEB RAS). Vladivostok, Russia. 1979–present time: Lab. of Optics & Electrophysics of Nanostructures IACP FEB RAS. Scientific interests: selective and controlled film growth; physical and chemical processes on surface and interface; UHV deposition; silicide films; semiconductors; layered structures; photovotaics; thermoelectrics; optoelectronics; nanomagnetism.

Kossi Bollanigni Amey
Research, Innovation and Development Structure (SRID), FORMATEC Institute, Laboratory of Structures and Mechanics of Materials (LaS2M), Polytechnic School of Lomé (EPL), University of Lomé Lomé, Togo

Law of distribution of quantities of shells on togolese littoral

This study aims at analyzing the repartition of the quantities of shells of sand sediments of Togolese littoral, and at determining the law underlying their longitudinal and transversal distributions. Samples (210), collected all along Togolese littoral starting from Togo-Ghana border up to Togo-Benin border, are subject to the test of sieving. Each refusal on sieve is tested against con-struction of shells by hydrochloric acid. The determination of the quantity of shells according to their size and to longitudinal and transversal distributions on the littoral is completed. As a conclusion, the quantity of shells in the se- diments is getting lower and lower starting from the aerial mid-beach (14.2%) to the mid-foreshore (11.80%), and getting higher and higher from the mid-foreshore (11.80%) to the low-foreshore (13.32%). It is getting lower and lower according to the direction of sediments' transportations. This quantity of shells is high (40.87%) in the fine-grained sands (□<0.125 mm) and coarse-grained sands (□>2 mm) and low (>24.26%) in the average-grained sands (0.125 mm≤□≤2 mm). The average quantity of shells of 12.67% is lower than the recommended maximum quantity (30%) for the sands used for concrete. Thus, for the concrete works, the littoral sands might be seen as useful since they are granulating for concrete.

Audience Take Away Notes

- Construction companies using sand from the literals have models that allow them to optimize the extraction of sand and shells, thus avoiding excessive exploitation of sediments for civil engineering works
- Through this study, the shell rates of coastal sands in Togo are available, allowing construction stakeholders in areas surrounding the coast to make decisions on sand exploitation and shell extraction based on the intended use
- The models developed on the variation in shell rates can be verified for other coastal sediments around the world, allowing an expansion of the operating conditions for this material
- Since shell rates in aggregates are regulatory to avoid poor quality concrete, designers therefore have a decision-making tool on sand extraction areas based on shell content limits

Biography
Born in Agbandi, Togo, Prof. Dr. Kossi Bollanigni AMEY holds a Doctorate in Engineering Sciences from the University of Lomé, Civil Engineering Option after a Design Engineering degree and a Higher Education Diploma in Computer Science. A lecturer-researcher and member of the Laboratory for Research on Structures and Mechanics of Materials (LaS2M) of the Ecole Polytechnique de Lomé (EPL), University of Lomé, Togo, Amey is Director of the Research, Innovation and Development Structure (SRID) and Chairman and CEO of the FORMATEC Institute. He is the author of several books, articles, and scientific course materials.

A.N. Belousov[1,2*], E.Yu. Belousova[1], Ye.V. Lekomtseva[3]
[1]Laboratory of Applied Nanotechnology of Belousov, Ukraine
[2]Kharkiv National Medical University, Ukraine
[3]Institute of Neurology, Psychiatry and Narcology of NAMS of Ukraine, Kharkiv

Efficiency of nanoparticles (Micromage-B) in the complex treatment of multiple sclerosis

Multiple Sclerosis (MS) is a serious neurological problem because of its high prevalence, chronic course, frequent disability, and propensity to affect young people. The immunopathogenesis hypothesis underlies the origin of MS. Selective sorption activity of biocompatible magnetite nanoparticles against surface proteins of cell membranes, circulating immune complexes, lymphocytotoxic antibodies, complement system, the effect of increasing phagocytic activity and leukocyte phagocytosis completion index allows the effective use of these nanodevices for immunocorrection. The main goal of the study is to slow down the progression of MS, improve the neurological status and general condition of the patient, and reduce the dynamics of the spread of demyelinating foci in the brain. Materials and methods: a patient diagnosed with multiple sclerosis, secondary progressive type of course, cerebro-spinal form, clinical aggravation stage; EDSS neurological status and disability assessment scales; contrast-enhanced MRI of the brain. An oral form of the nanodevice Micromage-B was used as an immunosorbent and immunomodulator. The choice of the regimen and dosage of Micromage-B was personalized. Assessment of the general condition and neurological status was performed every 7 days for 6 months. Contrast-enhanced MRI of the brain was performed at the 5th month of the study. As a result of using Micromage-B in MS treatment, objective improvement of neurological status, reduction of stiffness and rapid fatigability of the lower extremities were observed. Gait and coordination improved, hand tremors decreased, depression and signs of concentration disorders disappeared, appetite restored, and speech improved. During the entire period of Micromage-B application, positive dynamics in the normalization of the neurological status was observed. After 6 months of treatment, the total score dropped by 210 to 45. It was found that the maximum positive effect was observed in the evaluation of the pyramidal system and coordination. The EDSS Disability Scale score decreased from 6.0 to 5.0. Contrast-enhanced MRI brain examination for the first time showed a decrease in the number of new foci of demyelination in the brain by the 4th month of Micromage-B administration. The positive dynamics of normalization of the neurological status correlated with the results of brain MRI. The process of recovery of central nervous system activity in MS is not only due to the immunosuppressive properties of magnetite nanoparticles, but is probably caused by the activation of remyelination mechanisms and oligodendrocyte differentiation through enzymatic methylation. Considering the above, the use of biocompatible nanodevices in the complex treatment of MS is a promising direction. The scheme and method of using biocompatible magnetite nanoparticles to improve the effectiveness of MS treatment require further improvement and study.

Audience Take Away Notes

- The results of the study expanded the range of clinical efficacy of biocompatible magnetic nanoparticles in the therapy of severe autoimmune diseases
- The use of nanopreparation Micromage-B in the treatment of MS had a pronounced positive clinical

effect on the restoration of neurological status, objectively contributed to a reduction in the number of new foci of demyelination in the brain

- The process of recovery of CNS activity in MS is not only due to the immunosuppressive properties of magnetite nanoparticles, but is probably caused by the activation of remyelination mechanisms and oligodendrocyte differentiation through enzymatic methylation
- The use of biocompatible nanodevices in the complex treatment of multiple sclerosis is a promising direction
- The scheme and method of using biocompatible magnetite nanoparticles to improve the effectiveness of MS treatment require further improvement and study

Biography

Andrey Nikolaevych Belousov is Doctor of Medicine degree on speciality-Anesthesiology and Intensive Care. Author a new medicine products–nanotechnology preparations based on magnetite nanoparticles (Fe_3O_4) (www.nanolab.com.ua): Micromage-B (officially registration in Ukraine); Magnet-controlled sorbent brand of MCS-B for extracorporeal detoxication of biological liquids (officially registration in Ukraine and was allowed for medical practice); NanoBiocorrector for intravenous application–ICNB (intracorporal nanosorbent). A.N. Belousov is author new method of extracorporeal hemocorrection using magnet-controlled sorbent (MCS-B). The published more 280 scientific works on results application of nanotechnology preparation in experimental and practical medicine. At now Andrey Belousov - the Head of Laboratory Applied Nanotechnologies in Ukraine, DM, Professor of Kharkiv National Medical University, Ukraine.

A.N. Belousov[1,2*], E.Yu. Belousova[1], Ye.V. Lekomtseva[3]
[1]Laboratory of Applied Nanotechnology of Belousov, Ukraine
[2]Kharkiv National Medical University, Ukraine
[3]Institute of Neurology, Psychiatry and Narcology of NAMS of Ukraine, Kharkiv

Innovative method of nanotechnology application in the complex treatment of multiple sclerosis

Multiple Sclerosis (MS) is a serious neurological problem because of its high prevalence, chronic course, frequent disability, and propensity to affect young people. The immunopathogenesis hypothesis underlies the origin of MS. Selective sorption activity of biocompatible magnetite nanoparticles against surface proteins of cell membranes, circulating immune complexes, lymphocytotoxic antibodies, complement system, the effect of increasing phagocytic activity and leukocyte phagocytosis completion index allows the effective use of these nanodevices for immunocorrection. The main goal of the study is to slow down the progression of MS, improve the neurological status and general condition of the patient, and reduce the dynamics of the spread of demyelinating foci in the brain. Materials and methods: a patient diagnosed with multiple sclerosis, secondary progressive type of course, cerebro-spinal form, clinical aggravation stage; EDSS neurological status and disability assessment scales; contrast-enhanced MRI of the brain. An oral form of the nanodevice Micromage-B was used as an immunosorbent and immunomodulator. The choice of the regimen and dosage of Micromage-B was personalized. Assessment of the general condition and neurological status was performed every 7 days for 6 months. Contrast-enhanced MRI of the brain was performed at the 5th month of the study. As a result of using Micromage-B in MS treatment, objective improvement of neurological status, reduction of stiffness and rapid fatigability of the lower extremities were observed. Gait and coordination improved, hand tremors decreased, depression and signs of concentration disorders disappeared, appetite restored, and speech improved. During the entire period of Micromage-B application, positive dynamics in the normalization of the neurological status was observed. After 6 months of treatment, the total score dropped by 210 to 45. It was found that the maximum positive effect was observed in the evaluation of the pyramidal system and coordination. The EDSS Disability Scale score decreased from 6.0 to 5.0. Contrast-enhanced MRI brain examination for the first time showed a decrease in the number of new foci of demyelination in the brain by the 4th month of Micromage-B administration. The positive dynamics of normalization of the neurological status correlated with the results of brain MRI. The process of recovery of central nervous system activity in MS is not only due to the immunosuppressive properties of magnetite nanoparticles, but is probably caused by the activation of remyelination mechanisms and oligodendrocyte differentiation through enzymatic methylation. Considering the above, the use of biocompatible nanodevices in the complex treatment of MS is a promising direction. The scheme and method of using biocompatible magnetite nanoparticles to improve the effectiveness of MS treatment require further improvement and study.

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- The use of biocompatible nanodevices in the complex treatment of multiple sclerosis is a promising direction
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Biography

Andrey Nikolaevych Belousov is Doctor of Medicine degree on speciality-Anesthesiology and Intensive Care. Author a new medicine products–nanotechnology preparations based on magnetite nanoparticles (Fe_3O_4) (www.nanolab.com.ua): Micromage-B (officially registration in Ukraine); Magnet-controlled sorbent brand of MCS-B for extracorporeal detoxication of biological liquids (officially registration in Ukraine and was allowed for medical practice); NanoBiocorrector for intravenous application–ICNB (intracorporal nanosorbent). A.N. Belousov is author new method of extracorporeal hemocorrection using magnet-controlled sorbent (MCS-B). The published more 280 scientific works on results application of nanotechnology preparation in experimental and practical medicine. At now Andrey Belousov-the Head of Laboratory Applied Nanotechnologies in Ukraine, DM, Professor of Kharkiv National Medical University, Ukraine.

Anis Rahman
Applied Research & Photonics, Inc., Harrisburg, PA 17111, USA

Nanotechnology and T-ray imaging for enabling a smarter AI and LLMS for medical diagnostics and other applications

Artificial Intelligence (AI) or digital intelligence has spared a wave in modern computing community for its interactive applications. However, AI is not capable of creating new knowledge or new concepts; it only finds results from what is already known, but its ability for massive search and algorithm crunching for arriving at conclusions is remarkable. In other words, AI is not a thinking machine, nor it can ever become a concious entity, although its role in pattern matching and automation is undeniable due to the modern neural network algorithms and other AI tools. So, why AI cannot create new knowledge? How could nanotechnology help AI to assemble new knowledge?

We have seen that the advent of nanotechnology enhances just about any area of modern technology, from agriculture to semiconductors, and beyond. So, "can nanotechnology enhance the AI for knowledge creation?" The answer unfortunately is not a straightforward yes or no. However, at the current stage, nanotechnology could play a pivotal role in augmenting AI's ability towards assembling new knowledge by enabling advancements in nanomaterials, nanosensors, and higher computational capacities. A few keyways nanotechnology could empower AI will include enhanced computing power: Nanocomputing leverages nanoscale materials and designs to significantly increase computing power, providing AI systems with more robust computational abilities to process complex data sets and algorithms. The main power of any AI systems (e.g., a Large Language Model, "LLM") comes from the computations it performs to sort out the huge libraries on which it is trained, and thus match the most probable answer. Therefore, if the computing power is enhanced that will certainly help enhancing the scope of AI, such as handling even bigger training space than currently possible. Examples include, constructing neural networks with even more parameters and tokens specific to a given LLM, higher order computations of the integro-differential equations for weather forecasting, and/or sorting LLMs with more parameters and tokens for a stockmarket, etc. Therefore, faster, and cheaper computing power is a definite enhancement for AI, which can be enabled by nanotechnology.

T-ray imaging can be useful for AI applications in several ways. High-resolution imaging for data analysis: T-ray imaging provides very high-resolution data, which can be analyzed using AI techniques such as Machine Learning (ML), Deep Learning (DL), and Reinforcement Learning (RL). AI can be used to interpret the large complex datasets generated by T-ray imaging, enabling applications in non-destructive evaluation, biomedical diagnosis, security screening, and materials characterization. The lattice image of nickel shown in Fig. 1 was generated by T-ray nanoscanning 3D imaging system. These images were used for quantification of lattice dilation, which is the begenning of embrittlement in many metallic structures, leading to damage and failure. Such image can be pixelated and fed into an LLM for identifying and predicting failure mechanism before the occurance of actual failure.

Another specific example of AI-assisted T-ray imaging for medical applications is the acute lung injury therapy. In this case, AI-assisted T-ray image could be employed to identify biological tissue samples encased in paraffin, demonstrating its potential for medical diagnosis and therapeutic purposes. AI-assisted T-ray imaging can enhance the accuracy and efficiency of cancer detection and diagnosis. These examples highlight the potential of AI-assisted T-ray imaging in biomedical applications for cancer detection, tissue health monitoring, etc., thus advancing healthcare technologies. Some details of the T-ray technique will be discussed in terms of real-world data.

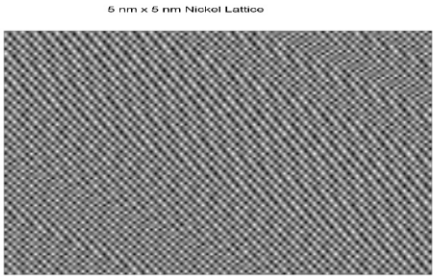

Fig. 1. T-ray image of spray depositted nickel lattice (5nmx5nm) showing evidence of lattice dilation due to high electric filed stress.

Biography

Dr. Anis Rahman is an acclaimed scientist in the field of semiconductors and nanotechnology. Known for the "Rahman-Tomalia" effect, he won scientific awards including NASA Nanotech Brief's "Nano-50" award twice; CLEO/Laser Focus World's "Innovation award." Anis founded Applied Research & Photonics (ARP), a leading Terahertz (T-ray) company in Harrisburg, Pennsylvania, serving the semiconductor and nanotechnology industry among others. Dr. Rahman invented the "Dendrimer Dipole Excitation," a new mechanism for high power, continuous wave T-ray generation. ARP has created several new scientific instruments including a cameraless lattice resolution volume imaging technology that can see and analyze below the surface of semiconductors and nanomaterials. Anis is a recognized scientific leader and member of scientific organizations including the American Chemical Society (ACS) and senior life member of The Optica.

Azzedine Bensalem
Long Island University, United States

Synthesis, characterization and mechanical properties of nano metal-substituted hydroxyapatite and metal oxides/hydroxyapatite nanocomposites

Addressing metal deficiencies in synthetic Hydroxyapatite (Hap) is proposed as a way to enhance Hap's mechanical properties. Previous studies suggest that incorporating metals or metal oxides improves fracture toughness and reduces brittleness.

This study investigates the effects of two metal incorporation methods on Hap's mechanical properties: The first method consists of incorporating metals by replacing some calcium in the Hap structure via substitution. The second method consists of modifying Hap by preparing (metal oxide)/Hap composites.

Nano powders of pure Hap, substituted Hap ($Ca10-xMx(PO_4)_6(OH)_2$), and (MO)x/Hap composites (M=Mg, Zn) with x=0.0, 0.1, and 0.3 were synthesized using a low-temperature technique. (ZnO)x/Hap nanocomposites were prepared by precipitating zinc oxide nanoparticles in a nano Hap slurry, while (MgO)x/Hap composites were prepared by precipitating Hap nanoparticles in a diluted nano MgO slurry.

XRD, FTIR, and SEM analyses identified Hap as the only crystalline phase present, with a uniform morphology and particle sizes ranging from 40 to 100 nm. EDAX analysis confirmed the presence of Ca, P, and O in pure Hap, and Ca, P, O, Mg, and Zn in both substituted Hap and (MO)x/Hap composites.

Mechanical testing, which included breaking force, work of fracture, and brittleness/ductility evaluations, demonstrated that modifying Hap with metal oxides significantly enhanced its mechanical properties compared to calcium substitution for the same quantity and type of incorporated metal. Optimal mechanical strength was observed in (MO)x/Hap composites with a 0.1:1.0 MO: Hap mole ratio (M=Mg, Zn).

Biography

Azzedine Bensalem, Full Professor. Chairman, Natural Sciences. Ph.D. from Université de Nantes (France), Post-doc at Polytechnic University of New York. Visiting Follow at Ecole Polytechnique, France. Chairman of the Natural Sciences (chemistry, biochemistry, math, and physics). Prior to this appointment, served as Chairman of the department of Chemistry and Biochemistry for 12 years, Chaired the LIU committee of Chairs for 2 years, and for several years, Chaired the department Appointment Reappointment Promotion and Tenure committee. Azzedine Bensalem's areas of research include largely focused in the area of Materials Chemistry. At the present time, my interest in this area lies mainly in the development of new strategies for the custom design of materials with derived and controllable properties, and of new methods of synthesis. With this in mind, my focus has always been on developing low temperature synthetic techniques. Low temperature routes for the synthesis of new materials are of great interest, since kinetics usually dominates thermodynamics under these conditions. The use of low temperatures allows the preparation of solids with very fine particles and very high surface area. These are very desirable properties in a number of applications. Several materials of great technological interest have been prepared in my research laboratory. Indeed, we prepared materials such as Transition metal oxides as well as lithiated transition metal oxides with applications in lithium batteries. The same synthetic technique with a slight modification was used to prepare Nano-materials for electronic and biomedical applications. Recent research work focused on synthesizing Nano-bioceramics with improved bactericidal and mechanical properties for bone-engineering application.

Babaghayou Meriam Imane[1,2*], Abdel-Hamid Ismail Mourad[3]

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[3]United Arab Emirate University, Mechanical Engineering Department, Al Ain, UAE

Exploring heterogeneity: Microstructural and mechanical evolution of monolayer LDPE greenhouse films under natural ageing

This study investigates the dynamic interplay between chemical structural changes and mechanical alterations in stabilized and unstabilized LDPE films during the photodegradation process. By employing RAMAN spectroscopy and Depth Sensing Indentation (DSI) experiments, we delve into the depth profile of these transformations, shedding light on the heterogeneous nature of LDPE degradation. Our findings underscore the pivotal role of surface degradation, where oxygen diffusion and UV light attenuation trigger spatially varying degradation patterns, with degradation initiating at the exposed surface and diminishing in intensity towards the film's core. Notably, chemical reactions, particularly chain scission reactions, predominantly manifest on the film surfaces, indicative of potential secondary crystallization. Nanoindentation results further corroborate these observations, revealing a nuanced interplay between crystallinity distribution and mechanical properties across the film's thickness. By elucidating the depth profile of chemical and mechanical degradation, our study advances the understanding of LDPE photodegradation, offering valuable insights for optimizing LDPE films' performance and durability in realworld applications.

Audience Take Away Notes

- Understanding the spatial distribution of chemical and mechanical changes in LDPE films during photoageing: The presentation will elucidate how photodegradation affects the LDPE film's surface and how these changes propagate through its thickness. This knowledge will provide insights into the spatial patterns of degradation within the material
- Application of Raman spectroscopy and Depth Sensing Indentation (DSI) techniques: Attendees will gain knowledge about the practical application of advanced analytical techniques such as Raman spectroscopy and DSI for characterizing the chemical and mechanical properties of polymers. They will learn how these techniques can be employed to study the depth profile of degradation in LDPE films
- Potential for interdisciplinary research and teaching: The research findings presented can serve as a valuable resource for other faculty members interested in interdisciplinary research or teaching. The study integrates aspects of materials science, spectroscopy, and mechanical testing, offering opportunities for collaboration and curriculum development across disciplines
- Practical solutions for polymer design and engineering: The presentation will highlight how the insights gained from this research can contribute to the development of practical solutions for polymer design and engineering. By understanding the spatial distribution of degradation in LDPE films, designers and engineers can optimize material selection, enhance product performance, and extend product lifespan in outdoor applications

Biography

Dr. Babaghayou Meriam Imane earned her State Engineer degree in Chemical Engineering from Laghouat University in 2004. She pursued her passion for research, obtaining a Magister degree in Chemistry in 2011 and a Ph.D. in 2017. Her research focuses on the degradation of polyethylene films, and she has expanded her expertise to include waste valorization and the development of new plastics and composites from waste materials. Since 2012, she has been a lecturer at ENS Laghouat and currently serves as the Director of the Applied Chemical and Physical Sciences Laboratory. Dr. Babaghayou leads the Materials Science, Characterization, and Valorization research group.

Dr. D. R. Patil
Dir. BNMRL, Jalgaon, India, North Maharashtra University, Jalgaon, India

(0, 1 and 2) dimensional hybrid architecture of the synthesized materials leads the smart sensing of the gaseous species at low/room temperature

A large number of scientists and researchers are paying their devotion in the development of gas sensors for the detection of toxic, hazardous, combustible and inflammable gases. Yet, few sensors are lagging behind in the wide range of their applicability due to some persistence of their limitations of sensing the gases below Threshold Limit Value (TLV), lack of selective nature to a particular gas among the presence of various gases, high cost, large response and recovery time, etc. All these features of the sensors mainly depend on and co-related with various architectures prepared during the synthesis of the materials, crystallite size, thickness of sensor, nature of activators and their concentrations, microstructures and nanostructures, operating temperature, etc. The disc type ultrasonicated microwave assisted centrifuge technique has been used in the synthesis of the materials at nanoscale in various dimensional architecture. The materials in the form of thick films are utilized as the gas sensing elements. The electrical behavior and gas sensing performance of the nanocomposites have been investigated in our laboratory. The efforts are made in the said direction to develop the smart gas sensors by using hybrid nanomaterials, viz. ZnO, Bi_2O_3, SnO_2, MnO_2, MnO_2, etc. The co-relation of sensor performance with architecture, crystallite size and shape, operating temperature, gas concentrations, film thickness, type of activators and their concentrations, surface activation, etc. will be presented and discussed.

Keywords: Hybrid Architecture, Smart Sensors, TLV.

Biography

Dr. D. R. Patil (Ph. D. Materials Science) now is the Principal and Head of Dept. of Physics, Recognized Research Guide and Director of the Bulk and Nanomaterials Research Laboratory, Rani Laxmibai Mahavidyalaya, Parola Dist. Jalgaon, MHS, Coordinator of All India Survey on Higher Education, Chairman of National Leprosy Elimination Programme, Member of Loknyayalaya, Life Member of Indian Science Congress Association, Crystal Research Society Chennai, Indian Association of Physics Teachers, Society for Materials Chemistry, BARC, Mumbai, Academic Council of Science Editors, Dubai, Ex-full Member of American Nano Society, IFSA Spain, etc. His topics of interest are: semiconducting and ceramic gas sensors, photoconducting and photo luminescent materials, nanomaterials, thin and thick film Physics, food freshness, disease diagnosis, etc. He established a research laboratory named as Bulk and Nanomaterials Research Lab, at his institution. Currently, he is working as a reviewer for the most reputed journals from Elsevier, ACS, AIP, etc. publications, as well as for few international events. Numbers of research scholars across India are working in his laboratory under his supervision. He delivered more than 74 scientific talks in various national and international events. He worked as a judge for oral and poster presentations, chaired the sessions, coordinated the events, worked as a resource person, etc. in various events. He is fully engaged in research activities in nanotechnology.

Delia Teresa Sponza
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Photodegradation of endocrine disruptors namely methyl p-hydroxybenzoate, and ethyl 4-hydroxybenzoate with n-doped biobr nanocomposite

The Endocrine-Disrupting Compounds (EDCs) are exogenous substances able to alter the structure or function(s) of the endocrine system and cause adverse effects on several organisms, their progeny, populations, or subpopulations. There are few reports in the literature about the modification of BiOBr with N. There are no reports about N-doped BiOBr for the degradation of methyl p-hydroxybenzoate, and ethyl 4-hydroxybenzoate EDCs. Therefore, due to the environmental problem of EDCs in water sources, the main objective of this work was to photodegdate two EDCs in water using the N-doped BiOBr photocatalyst under UV-Vis radiation, reducing the toxicity level of the mixture. Therefore, N-doped BiOBr semiconductor was prepared under laboratory conditions. The N20BiOBr semiconductor showed the highest photocatalytic activity achieving the complete photodegradation of the EDCs, and 98-99% of mineralization in 25 min. The high efficiency of N20BiOBr for EDCs removal was attributed to the increase of the specific surface area and the effective separation of photogenerated charges by effect of N incorporation. The main photogenerated species involved in the degradation of the pollutants were the superoxide radicals ($O_2^{\bullet-}$) and photo-holes (h^+), and a possible photocatalytic activation mechanism was proposed where suggests the active participation of oxygen vacancies. The effects of nanocomposite concentrations, sun ligth power, EDC concentrations, photodegradation time Ph and temperature on the photodegradation yields of methyl p-hydroxybenzoate, and ethyl 4-hydroxybenzoate was studied. The acute toxicity performed by Daphnia showed 98% toxicity reduction after photodegradation.

Keywords: Photodegradation, Endocrine Disruptors, Methyl P-Hydroxybenzoate, Ethyl 4-Hydroxybenzoate, N-Doped Biobr Nanocomposite, Acute Toxicity

Audience Take Away Notes

- The audience can apply the knowledge gained to real-world scenarios and challenges
- This will be highly effective in enhancing their skills and job performance
- It offers a practical solution that simplifies and enhances design efficiency
- It will enhance design accuracy and offer new insights for problem-solving

Biography

Prof. Dr. Delia Teresa Sponza is currently working as a professor at Dokuz Eylül University, Department of Environmental Engineering. Scientific study topics are; Environmental engineering microbiology, Environmental engineering ecology, Treatment of fluidized bed and activated sludge systems, Nutrient removal, Activated sludge microbiology, Environmental health, Industrial toxicity and toxicity studies, The effect of heavy metals on microorganisms, Treatment of toxic compounds by anaerobic / aerobic sequential processes, Anaerobic treatment of organic chemicals that cause industrial toxicity and wastewater containing them, Anaerobic treatability of wastewater containing dyes, Treatment of antibiotics with anaerobic and aerobic sequential systems, Anaerobic and aerobic treatment of domestic organic wastes with different industrial treatment sludges, Treatment of polyaromatic compounds with bio-surfactants in anaerobic and aerobic environments, Treatment of petrochemical, Textile and olive processing industry wastewater by sonication, Treatment of olive processing industry wastewater with nanoparticles and the toxicity of nanoparticles. She has many international publications with an H index of 42 and 6000 citations.

Gabriel Beltrán[1*], Francisco Lahuerta[1], Belén Hernández-Gascón[1], Vaia Tsiokou[2], Alexandra Papatheodorou[2], Anna Karatza[2], Vanessa Lislevand[3], Elias P. Koumoulos[3], José Manuel Bielsa[1]

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Development of a digital engineering tool for estimating the impact of micro-defects on the mechanical response of 3D-printed filaments

In recent years, the construction sector has been developing efficient materials and technologies to support the real implementation of nearly zero-energy/emission and plus-energy buildings with high indoor environment quality. This last aspect is particularly important on health, comfort, productivity and, in general, the wellbeing of building occupants. Among the new design strategies that seek to meet these wellbeing requirements are 3D printed components, highlighting the process known as Fused Filament Fabrication (FFF). This is a 3D printing process where a filament of material is melted and deposited layer by layer to create a three-dimensional object. It should be noted that during this filament deposition process, micro-defects can arise, affecting both the quality and the mechanical properties of the component. To detect these errors, some manufacturers opt for an online monitoring of the production process by capturing images. As a result, rich information is captured through these images since the defects are categorised and dimensionally characterised by means of Machine Learning (ML) techniques. However, the impact of the defects detected on the mechanical response is not addressed.

Within this background, a parametric Finite Element (FE) based approach has been developed in this work with the objective of analyzing the influence of the 3D FFF printing micro-defects on the mechanical response of the component. In the FE models, the geometrical dimensions of the defects (inputs) have been parametrized to relate them to the stiffness variation (output) that occurs in the filaments. Building on a Design of Experiments (DoE), results from a batch of simulations are used to generate metamodels for each type of defect, which could be further implemented in secondary applications, such as in line defect detection. In this work, a virtual digital tool, which is built from these metamodels, was developed to calculate, in real time, how the stiffness of the filaments varies as a function of the geometrical dimensions of the micro-defects.

Audience Take Away Notes

- Our contribution provides the 3D printed manufacturing community a FE-based strategy to evaluate the impact of the defects on the mechanical response of the component
- FE-based tools can be used to create a virtual representation of a real operational environment. The numerical tool defined in this work culminates in an easy-to-use tool that make models accessible to industrial end-users
- The methodology presented could be expanded to other situations to obtain real-time estimations of a system or a process, based on a limited number of FE simulations or experimental results
- The methodology implemented is a powerful channel to provide an end-user-focused virtual environment to exploit the previous knowledge collected compiling rich data and can be used in multiple fields of science and technology

Biography

Dr. Gabriel Beltran obtained MSc degree in Mechanical Engineering by the University of Zaragoza (2017). He started working at Instituto Tecnológico de Aragón (ITA) in 2018 as FEM engineer in the group of "Advanced Modelling and Characterization of Materials". His work is focused on the development of constitutive models that reproduce the mechanical response of materials, including hyperlasticity, viscoelasticity, plasticity and fatigue, especially of elastomeric materials. He has participated in several R&D projects public and privately funded. He has recently obtained (2023) a PhD degree in mechanical engineering at University of Zaragoza. He is co-author of three scientific papers and has participated as a speaker at three international congresses.

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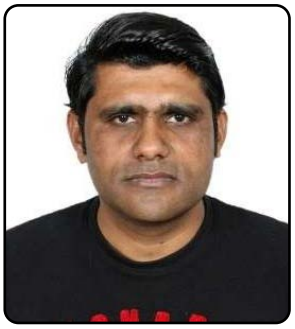
44 years' experience with fibre reinforces polyurethane railway sleepers

In the 1970ties FFU–fibre reinforces foamed urethan-was developed by Japanese Railways in cooperation with Sekisui Chemical Co. Ltd. Here you will get information about the production process, the summery of many material performance tests done by technical Universities. As well as lateral resistance in the track, minus 65-degree Celsius full body performance of the material and how it act under vandalism fire tested in a lab. As well as the performance of this technology after 30 years used in track tested and reported by the Railway Technical Research Institute of Japan.

Audience Take Away Notes

- Understand material behavior best, for their calculations, for their installations
- Understand where they could use it for projects, consult clients of them, can better compare with similar technologies, helps to choose the best technologies of many for their projects, get an alternative solution technology
- A lot of bachelor thesis, master thesis as well PhD papers are already prepared and still under preparation on Universities in Europe to get deeper and deeper understanding of the material behavior in the field of railways as well as constructions
- It does indeed help railway engineers for designing the best track at bridge, switch and agricultural level crossings for 33 t axle load. Furthermore, solutions for special areas where not enough railway clearance is given
- This research work will play a vital role for railway bridges, switches, level crossings, temporary stations and further
- all other benefits
    - Not influenced by weather, withstanding many chemicals used and transported by railways, very long lifetime, bespoke solutions–everything you can show on drawings you can get. Better to go with at bridges according to a life cycle cost analysis for bridges and switches. Minimize maintenance costs for switches according to a master thesis from a German railway member, Linear elastic material behavior under bending

Biography
Dr. Gunther Koller studied civil engineering at the technical University in Vienna and graduated as Dipl.-Ing. In 1991. Then he became assistant at the technical University at the Institute of Construction Process and Construction Economics. He referred his PhD (Dr. techn.) in 1994 at the same institute. After that he build bridges in Austria, Germany and Ireland, Metros in Vienna and Munich. Two Hydro power stations in Turkey, Railway tunnel in Switzerland. In 2004 he become head of railways at Rhomberg. In 2006 he opened koocoo technology & consulting GmbH. It does business development for technologies like synthetic sleeper, ground stabilization, noise and vibration. He did more than 60 professional articles and 40 presentations on international symposiums.



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The art and science of Metal-Organic Frameworks (MOFS): A journey from conventional to contemporary techniques

Metal-Organic Frameworks (MOFs) have been captivated research for over three decades due to their unique structure and diverse applications. These fascinating materials boast remarkable porosity and well-defined morphological characteristics precisely controlled through a different synthesis methods. From traditional techniques (mechanochemical/electro-chemical) to more advanced approaches (micro-wave/ green synthesis), researchers can tailor MOF properties for specific needs. In this review study, we exploring the diverse synthesis routes, characteristics, and promising applications of these MOFs. We examined the evolution of MOF synthesis methods, highlighting both traditional and advanced techniques. The characterization techniques employed are also explored, encompassing established tools and innovative approaches that provide a comprehensive understanding of MOF structure, like morphology, pore size and crystallinity etc. However, advanced tools like Nuclear Magnetic Resonance spectroscopy (NMR) and BET analysis offer insights into the atomic-level details and surface area characteristics of these materials. This focus on synthesis and characterization allows us to delve deeper into the potential of MOFs for environmental applications, particularly water and air purification. By analyzing realworld examples from the literature, we showcased the effectiveness of both traditional and advanced MOFs in tackling these critical challenges. Despite significant progress, challenges still remain in MOF research. Unveiling the intricate details of MOF structure at the molecular level requires the development of more advanced tools and models. Additionally, time-efficient and scalable synthesis methods are crucial for realizing the full potential of MOFs in environmental applications.

Keywords: Metal Organic Frameworks (MOFS), Synthesis Routs, Characterizations, Molecular Level Details, Surface Area, Advanced Techniques, Water and Air Applications, Environmental Cleanup

Audience Take Away Notes

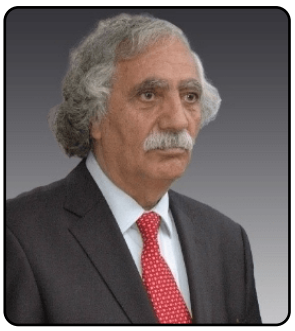
- **Versatile Materials for Environmental Cleanup:** MOFs are highly customizable materials with unique structures and pores. This allows scientists to "design" MOFs with specific properties for environmental applications, particularly water and air purification. The review explores how different synthesis methods (traditional and advanced) can be used to tailor MOFs for these cleanup tasks
- **Understanding MOF Structure is Crucial:** The effectiveness of MOFs depends heavily on their intricate structure. The review discusses various characterization techniques, both traditional and

advanced, that scientists use to understand MOF structure, morphology, and surface area in detail. This understanding is vital for further development and optimization of MOFs

- **Challenges and Future Potential:** Despite significant progress, challenges remain in MOF research. The review highlights the need for more advanced tools and models to fully understand MOFs at the molecular level. Additionally, developing faster and more scalable synthesis methods is crucial to unlock the full potential of MOFs for practical environmental applications

Biography

Hassan Nawaz is a PhD exchange student at University of Pittsburgh, USA. He completed his Master's degree in Environmental Sciences at Government College University, Faisalabad, Pakistan. Currently, He is pursuing his PhD (last year) in Environmental Sciences under the joint guidance of Dr. Muhammad Ibrahim (Government College University, Faisalabad, Pakistan) and Dr. David Sanchez (University of Pittsburgh-USA). His research focuses on the synthesis, characterization, and environmental applications of Metal-Organic Frameworks (MOFs), particularly their potential for removing heavy metals and emerging pollutants from water. His recent publication demonstrates the effectiveness of MOFs in tackling arsenic contamination in water.



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Examination of the p-T phase diagram of pure substances

The discovery of a point on the liquid vapor curve where the liquid phase ends was determined experimentally by Charles Cagniard de la Tour in 1822. In 1861, Thomas Andrews defined this point as the critical point and the critical parameters such as temperature, pressure and density (Tcr, pcr, ¤cr) which represent both liquid and vapor phases. At the point where the liquid vapor equilibrium curve ends, temperature represents two phases, while pressure and density do not represent two phases. In this case, only the Temperature is critical (Tcr). Pressure and density are parameters that correspond to the critical temperature and do not represent the critical situation. The uncertainty of the liquid-solid equilibrium curve and the pressure-dependent boundary range of the liquid phase in the p-T phase diagram is still unresolved and is one of the most important problems of physics and chemistry. The existence of the critical point occurs when one of the phases ends. Since liquid phase is located between the solid-vapor balance curves, it represents both phases. By heating the liquid vapor equilibrium curve, the vaporized liquid passes into the gas phase and the critical point is determined.

As an analogy, the pressure-dependent liquid-solid equilibrium curve freezes upon cooling and passes into the solid phase. The point where the liquid phase ends in the liquid-solid equilibrium curve defines the critical point. In this study, a specially designed experimental setup was used and the existence of a critical point on the liquid-solid equilibrium curve of benzene was determined, accompanied by discontinuous metastability at high pressure and temperature. In the experiments, the freezing temperature of the cooled liquid benzene increased with increasing pressure and the life time of the metastable liquid decreased, and ΔT and ΔP became zero at a certain pressure and temperature. In the experiments, the locations of the critical point depending on pressure and temperature in the temperature-time diagram showing the discontinuous metastable state along the liquid-solid equilibrium curve of benzene were determined as T = 356 K and P = 2229.2 bar. The pressure-dependent critical point P=2229.2 bar also determines the pressure-dependent limit range of the liquid phase of benzene.

Audience Take Away Notes

- First of all, as emphasized in the study, audience can learn that the theories presented by even Nobel-winning scientists should be questioned, and they can question all the information put before them in the future
- It opens a new horizon especially for researchers working on phase changes and can complete their missing information
- This study can definitely be used in the lectures of faculty members and in the research of other researchers working with phase change substances
- It cannot be said that it provides a practical solution that will make a designer's job easier

- Although it is clear that it will provide new information, it is not possible to say that it will benefit design problems
- Instead of solid-liquid transitions, which have been studied extensively to date, liquid-solid transition, that is, cooling of matter, contains very new information since it is a much less studied subject

Biography

Beycan Ibrahimoglu received his bachelor's degree in Mechanical Engineering from Azerbaijan Polytechnic University in 1971 and completed his doctorate at the same university between 1979-1982. He was the Prime Minister of Nakhchivan /Azerbaycan between 1991-1992. Serving at Gazi University as a Visiting Professor in 1994, Prof. Dr. Beycan İbrahimoğlu managed many projects carried out in the Chief Military Advisory of the Ministry of National Defense. In 2009, he established Anadolu Plasma Technology Center, an advanced engineering company, in order to bring creative and innovative solutions to unique engineering problems such as the environment, space, aviation, defense industry, and medical sectors.

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Structuring of water clusters under the solar influence and their copying by bulk water. Influence of the sun on the night side of the earth

Even 0.02% water in acetonitrile can form clusters, the size and chemical reactivity of which can change under the influence of the Sun in a very wide range. Bulk water added to such acetonitrile can copy and reproduce these original clusters and acquire different hydrolytic activities depending on the size of the copied clusters. As a result, the rate of hydrolytic reactions with the added water can vary greatly depending on where the acetonitrile was located before the reaction - outdoors, inside buildings or underground. This discovery sheds light on the water memory phenomenon and explains the reason for its experimental instability.

The influence of the Sun is accounted for by the decomposition of water clusters by muons, which are generated in the upper atmosphere by the solar wind. Due to the anisotropy of the muon flux the rate of hydrolysis depends on the geometry of the reaction solution, its position in space and constantly changes during the day depending on the position of the Sun in the sky.

For example, at noon, when the Sun is at its zenith, the rates of this reaction in three 5-mm NMR-tubes directed North-South, East-West and Vertically are considerably higher in the horizontal tubes, and at sunrise and sunset when the Sun shines along the East-West line the rate is higher in the vertical tube.

It was logical to assume that at night when the Sun irradiates the opposite side of the Earth, it cannot have the same influence as during the day, and the rates of this reaction in multidirectional NMR-tubes should become equal. However, experiments carried out at midnight did not confirm this. At night the rate of hydrolysis decreases substantially, but the distribution of rates remains the same as at noon-in the vertical tube the rate is significantly less than in the horizontal tubes. The same distribution of triethyl phosphite hydrolysis rates in multidirectional tubes day and night allows us to conclude that on the night side of the Earth the influence of the Sun is inducing the appearance of some radiation vertically from underground. The mechanism of the solar influence at night requires a detailed comprehensive study. Measuring the rate of hydrolysis of triethyl phosphite in acetonitrile in multidirectional 5-mm NMR-tubes at different locations on Earth at different latitudes may help to explain this fundamental phenomenon, which is important for biological, chemical, physical and environmental research.

Biography

Dr. Shevchenko studied Chemistry at the Kiev University, Ukraine and graduated as MS in 1979. He then worked at the Institute of Organic Chemistry in Kiev and received there his PhD degree in 1985. In 1990 he won Alexander von Humboldt scholarship and until 1996 was invited scientist at the Braunschweig University in Germany and at the Southern Methodist University in Dallas, Texas, USA. Then he worked in Kiev at the Institute of Bioorganic Chemistry and Petrochemistry and the Institute of Geochemistry Mineralogy and Ore Formation, Ukrainian Academy of Sciences. He has published more than 60 research articles.

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The impact of short and long term ageing in glycol water mixture on mechanical behavior of polyamide 6/glass fibers materials and recovery of properties after desorption process

The current paper aims to study the behavior of Polyamide 6 (PA6) and Polyamide 6 reinforced with 30% of short glass fibers (PA6GF30) under Glycol Water (GW) mixture (20:80) used for cars as coolant fluid at 50°C and 90°C for up to 80 days. First of all, the reversibility of short-term ageing of both materials was studied. Afterwards, the impact of long term ageing on the bulk properties was measured. Samples were fully immersed in the mixture of GW and periodically weighted. After reaching saturation state, samples undergo desorption and reabsorption cycles at the same ageing conditions. On the other hand, other samples were kept till 80 days of ageing. Results revealed ageing temperature has a crucial role on the desorption process. Thus at 50°C, residual glycol water were measured for both materials. However, it was fully dried for samples aged at 90°C. Regarding, mechanical characterization it was noticed that absorption process is a reversible mechanism only for PA6 aged at 90°C. Indeed, IR spectroscopy pointed out that both studied materials underwent a chemical hydrolysis after the second immersion (reabsorption). After 80 days of ageing, results gathered revealed the occurrence of substantial changes and the ageing is no longer physical in nature especially for PA6. Thus, the long term ageing leads to the formation of ester species due to thermo-oxidation as pointed out by Infrared spectroscopy analysis. Indeed, an overall loss of mechanical properties with a significant embrittlement of PA6 was noticed that can be attributed to a decrease of the level of entanglements within the polymer.

Biography

Dr. Imen graduated as Materials Engineer in 2010 from National Engineering School of Sfax (ENIS), Tunisia. She then joined the research group of Prof. Nader at Materials Engineering Department (ENIS-LGME). She received her Master's degree and her PhD degree in 2012 and 2017, respectively at the same school. Afterwards, she worked as an Assistant Professor at many institutions in Tunisia. She has published 6 research articles in SCI(E) journals.

Iuliana Laura Calugaru*, Hassine Bouafif
Centre Technologique des Residus Industriels (CTRI), Rouyn-Noranda, Quebec, Canada

Half-charring of dolomite mineral for applications in the passive treatment of mining effluents

The contact between waters and the components of a mine site like open-pit walls, waste rock piles, tailings, access roads, etc., engender effluents contaminated through minerals oxidative dissolution. According to their pH, mine effluents are mainly classified in acidic (Acid Mine Drainage; AMD, pH<6), circumneutral (Contaminated Neutral Drainage; CND, 6<pH<9), basic (pH>9), diluted, mineralized, or saline. The quality of mine effluents depends on the site mineralogy (the nature and the ratio of acidogenic and neutralizing minerals), climate (rain, snow melt, dryness) and mining operations (open pit / underground mining, chemicals employed). Mine effluents may contain significant concentrations of metals, metalloids, and anions, potentially harmful for humans and environment. Therefore, the treatment of mine effluents is mandatory, and for a mine in operation it can be carried out in water treatment plants. However, hundreds to thousands of years after the mine closure, mine drainage may still impact the environment, its passive treatment being hence the viable option. Passive treatment involves chemical, physical, and biological processes naturally found in the environment, and its set ups (drains, biofilters, wetlands) are preferred for their low cost of construction, operation, and maintenance.

Carbonates rocks as neutralizing minerals are often employed for the passive treatment of AMD. Among carbonates, although less employed than the lime ($Ca(CO_3)_2$), the dolomite ($CaMg(CO_3)_2$) is interesting since its reaction with SO_4^{2-} from the AMD engenders soluble MgSO4 and therefore reduce the passivation of the carbonate rock by gypsum coating ($CaSO_4 \cdot 2H_2O$).

Recently, the half-charring of the dolomite has been studied to produce a new material, $MgO \cdot CaCO_3$, which shows increased reactivity in the AMD/CND treatment. The origins of its improved performance are mainly the formation of MgO by the decomposition of $MgCO_3$, and the increased surface area of the new material by the release of CO_2. However, the parameters time/temperature in the charring process have to be properly assessed in order to maximize $MgCO_3$ decomposition without affecting the mechanical strength of the dolomitic stones. The mineralogy and the granulometry (predetermined in passive treatment systems, to preserve the flow properties) also impact the optimum charring conditions of the raw dolomite. In the present study, the half-charred dolomite produced will be employed in passive AMD/CND treatment systems on a closed mine site in Abitibi region of Quebec, Canada.

Audience Take Away Notes

- The approach to produce half-charred dolomite from raw dolomite, for a specific application: AMD/CND passive treatment in drains, will be presented. Dolomite is a largely available and underused raw material, while half-charred dolomite showed improved efficiency in AMD/CND treatment, stabilization of acidic soil, land restauration, gas adsorption

- Several scientific articles and conference presentations are available in the scientific literature on the subject treated in this presentation (the main author has a few contributions). The research work would be useful for specialists from the mining sector (professionals, students, professors), land reclamation and restauration specialists, forest and agricultural land specialists, environmental professionals
- Our research is up to date in the mining field
- The dolomite passive treatment system for mine drainage (AMD/CND) consists of the necessary number of modules filled with the mixture of dolomite and half-charred dolomite rocks to obtain treated effluents complying with provincial (Quebec) and federal (Canada) regulations. The modules will be easier to manipulate and replace in comparison to the drains currently employed
- The presentation will provide information concerning the utilization of a new and improved material for the passive treatment of mine drainage (AMD/CND)

Biography

Dr. Calugaru graduated Mineral Engineering doctoral program of Montreal University (2019). She works as project manager at the Centre Technologique des Residus Industriels (CTRI, Industrial Waste Technology Center) since 2012 and chemistry professor at the College of Abitibi-Temiscamingue since 2008. Dr. Calugaru works in the field of characterization of solids and effluents, physico-chemical and mineralogical modification of materials, passive and active treatment of mine waters, prediction of the quality of the mine drainage, metals recovery by chemical leaching. She has been involved as main researcher or co-researcher in several applied science projects. She has presented her research results in more than 30 scientific articles, conference papers and international conferences.

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Organofunctional silicon compounds – synthesis and application as anti-biocorrosion coating

Biological corrosion is the term referring to undesirable deposition and growth of all kinds of microorganisms, mainly fungi, bacteria and algae. It is a multistage and complex process leading to destruction of materials on which this deposition and growth, in the form of a biofilm, took place. The phenomenon leads not only to technological problems but can have harmful effects on human health. Most often this phenomenon is discussed in the context of construction materials such as bricks, concrete, roof tiles, glass and wood.

Production of advanced materials contributes to driving social and economic development, which in turn demands new materials of target properties to meet specific needs. New materials of strictly defined structure and properties are designed on the basis of results of fundamental studies.

Recently, the group of materials showing amphiphilic properties has become of increasing interest in the global search for materials of specific properties. Compounds with amphiphilic properties are very dynamically developing, multifunctional, because they are a compilation of chemical, biological and physical research. There is a wide range of applications of this group of which will reduce the surface tension. The amphiphilic character of the compound devised will be achieved by the introduction of polyether compounds that easily make hydrogen bonds with the water molecules in the solution thanks to the presence of oxygen in the ethylene bridges. It should be mentioned that the choice of siloxane as the core of the molecule has not been accidental. It shows some very important properties such as high thermal, chemical and antioxidative resistance and water vapor permeability. The innovative approach to the problem is the use of functionalized organosilicon compounds showing amphiphilic properties as the modifiers of the materials surfaces to be protected. The coatings based on functionalized organosilicon compounds and protecting against biological corrosion may be used for all kinds of supporting materials. For example, they can be used for protection of glass against the effect of the elements. In this presentation the selected surface properties were presented too. Design and production of coatings protecting against biofilm formation and negative effects of biological corrosion, is a top challenge of the current world material technology.

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Development of panchromatic push-pull dyes for dye-sensitized solar cells using computational and experimental approach

The development of highly efficient and economically favorable Photovoltaic (PV) devices is immensely needed to compete with the existing non-renewable energy sources which are detrimental to our environment. Emerging solar cells, such as Dye-Sensitized Solar Cells (DSSC), are promising alternatives due to their economical and facile device fabrication. In DSSC, the dye sensitizer plays a vital role in the light harvesting, charge generation, and charge transport. However, the design and synthesis of dyes still need substantial efforts to realize a highly efficient sensitizer. To hasten the advancement of these PV technologies, performing quantum chemical calculations can be an excellent aid to find the best organic dyes. This study presents combined computational approach and experimental investigations to evaluate and screen potential metal-free organic dyes. A series of Density Functional Theory and Time-Dependent Density Functional Theory (DFT/TD-DFT) computations was conducted to evaluate the absorption spectra and electrochemical properties of the designed organic dyes prior to the actual synthesis process. Particularly, this study presents DFT/TD-DFT calculations and experimental data for metal-free dyes based on semi-rigid triphenylamine and porphyrin dyes, which are among the highly utilized prototypes in the development of dyes for DSSCs.

Audience Take Away Notes

- The audience will be able to understand the vital role of dyes in Dye-Sensitized Solar Cells (DSSCs)
- The audience will be able to recognize the role of quantum chemical calculations in the development of dyes for DSSCs
- This research shows efficient development of dye sensitizer using combined computational and experimental investigations

Biography

Dr. Estrella-Pajulas received her MS in Chemistry (2016) and PhD in Physical Chemistry (2019) at Kunsan National University, South Korea. Her research was centered on the development of metal-free organic dyes for dye-sensitized solar cells which covers computational design of the novel dyes, synthesis of the designed dyes, and fabrication and optimization of the solar cell devices. Currently, she is an Assistant Professor at Silliman University, Philippines, and currently interested on the green synthesis of metal oxides nanoparticles as photocatalyst. She has published several peer-reviewed articles about DSSCs and metal oxide photocatalysts in SCI(E) journals.

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Enhanced grain refinement, precipitates regulation, and improved mechanical properties of cast Al-Li alloy by Ti addition and heat treatment

The cast Al-Li alloy is a promising material due to its high strength-to-weight ratio and stiffness. This presentation systematically revealed the impact of minor Ti addition and heat treatment on grain structure, precipitates, Precipitate-Free Zone (PFZ), and the performance of the Al-3Li-2Cu alloy. Minor Ti addition significantly refines the as-cast alloy, leading to a transition from columnar grains to equiaxed grains. This refinement is achieved through the formation of micro-sized Al3Ti primary phases and the introduction of Ti solutes. The primary Al3Ti phases, with a low mismatch (0.99%) to the matrix, act as heterogeneous nucleation sites for α-Al, while the presence of Ti solutes restricts grain growth. As a result, the average grain size can be refined to 35.2 μm by adding 0.2wt.% Ti. Besides, minor Ti addition affects the corresponding precipitation behaviour of the alloy. Detailed TEM observations reveal that the addition of Ti inhibits the growth of δ'(Al3Li) precipitates and the accompanying δ'-PFZ, which should be related to the interaction between Ti solutes and vacancies. Ti solutes preferentially combine with vacancies to form Ti-vacancy clusters, thereby reducing the concentration of effective free vacancies in the matrix, further decreasing the diffusion rate of Li atoms and vacancies, ultimately inhibiting the growth of δ' precipitates and δ'-PFZ. Besides, reducing the aging temperature exerts a similar effect. Finally, the 0.2 wt.% Ti-modified alloy exhibits excellent mechanical properties after aging at 175°C for 8 h. It demonstrates a high yield strength (272 MPa), a high ultimate tensile strength (399MPa), and an acceptable elongation (5.9%), which represent an increase of 8.8%, 34.8%, and 293.3%, respectively, compared to the alloy without Ti addition. The simultaneous improvement in strength and ductility is attributed to the presence of fine and equiaxed grains, high-density and homogenous δ' precipitates, and a narrow δ'-PFZ. In-depth discussions are provided to elucidate the underlying mechanisms governing the microstructure and mechanical properties. These findings provide valuable insights for the advancement of the high-performance and lightweight cast Al-Li alloy.

Audience Take Away Notes

- The refinement mechanism of cast Al-Li alloy through Ti addition will be systematically elucidated based on experimental and theoretical analyses, including comparisons with other refining agents
- The intriguing findings are expected to offer valuable insights into the refinement of Al and its alloys
- The impact of Ti addition and heat treatment on the precipitation behavior will be uncovered, serving as reference for the compositional design of Al-Li alloy
- The distinctive characteristics of precipitates in Al-Li alloy will be clarified, accompanied by a theoretical analysis of their influence on mechanical properties
- This presentation aims to provide valuable insights and establish a theoretical foundation for the production and development of cast Al-Li alloys

Biography

Mr. Shao graduated from Chongqing University (China) as BS in Metallurgical Engineering in 2017, and later as MS in the same field in 2020. In 2021, he embarked on a new academic journey by enrolling in Shanghai Jiao Tong University to pursue a Ph.D. degree. He focuses on the composition, structural design, and microstructure adjustment mechanisms of cast Al-Li alloy with high Li content. The impact of solute components, reinforcement particles, and heat treatment on the microstructure and mechanical properties have been investigated systematically. After years of dedicated research, he has published more than 10 research articles in SCI(E) journals.

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Sustainable building material made from bulrush with numerous unique selling points

Due to its special structural properties, the bulrush plant (Typha angustifolia) enables the production of building materials that offer a combination of insulation and load-bearing effect that is unique on the market. The suitability of the Typha leaf mass is determined by the structure of the plant. The leaves have a fiber-reinforced and stable supporting tissue, which is filled with a soft, open-cell sponge fabric. This results in both: remarkable statics and an excellent insulation effect. To produce the panels, relatively large particles are cut without fiber disruption and retaining the leaf structure. In this way, both positive properties of the plant, the strength, and the insulating effect, are transferred to the product. These particles are then bonded into panels with mineral adhesive (e.g. magnesite) using low pressure and energy. Using the procedure described above, the so-called “magnesite-bonded Typhaboard” can be produced as a building material with the following advantages. It shows excellent fire resistance and no smoldering as well as an easy processability with common tools used for working with wood. It has a natural mold resistance and therefore no additive biocides are necessary. Therefore, it can simply be composted and returned to the natural cycle.

Some pilot projects exist already, like the refurbishment of a half-timbered building in Nuremberg with energy and structural upgrading, a sauna house in Radolfzell as a timber frame construction with a 4.3 m grid and the Typha Pavilion at the EXPO Milan, which is an elementized solid construction as a self-supporting structure with molded parts. As the magnesite-bonded Typhaboard combines many construction-relevant properties (thermal insulation, statics/stiffening, fire protection, moisture protection, plaster base...) it is suitable for cost-effective element-based lightweight construction and shows good deconstructability or reuse capability (mostly screw connections).

For such production, we see the enormous advantage in the USA that there are huge natural stocks there, so the plant would not have to be cultivated first. This simplifies many things (compared to the situation in Germany) and could lead to a rapid entry into profitable building material production. There is also already a conclusive concept for the construction of a relatively small, continuously operating production plant, which can already be operated economically, which is of course scalable.

Audience Take Away Notes

- Knowledge of a new sustainable building material
- Possibility of using local occurrences of Typha angustifolia
- Multipurpose material to simplify construction and prevent damage

Biography

Prof. Dr.-Ing. Martin Krus studied chemical engineering at the University of Karlsruhe, graduating with a degree in engineering. He joined the Fraunhofer Institute for Building Physics in 1985 and has been working on the subject of moisture protection ever since. His responsibilities include building material development and testing in the field as well as hygrothermal calculations. He received his PhD from the University of Stuttgart in 1995 and in 2015, he was appointed honorary professor. He is also strongly committed to environmental protection with the development of building materials from renewable raw materials.

Maryam Shokravi
Energy Institute of Higher Education, Saveh, Markazi, Iran

Dynamic buckling of smart sandwich beam subjected to electric field based on hyperbolic piezoelasticity theory

CNTs have superior properties such as high tensile strengths, high aspect ratio, high stiffness and low density and however, can be used as the reinforce phase for the composite materials. In this paper, dynamic buckling of the smart subjected to blast load subjected to electric field is studied. The effect of CNTs on the forced vibration of micro cylindrical shell is presented. In nano and micro scales, considering size effect is essential. The sandwich structure is rested on Pasternak foundation with springs and shear elements. Applying piezoelasticity theory and Hyperbolic Shear Deformation Beam Theory (HSDBT), the motion equations are derived by energy method. For calculating the Dynamic Instability Region (DIR) of the sandwich structure, Differential Quadrature Method (DQM) along with Bolotin method is used. The effect of different parameters including CNTs volume percent and distribution type, boundary conditions, size effect and length to thickness ratio on the frequency response of the of the system was studied. It can be concluded that the FGX pattern was the best choice compared to other cases. It was observed that increasing the CNT volume fraction increases the frequency and decreases the deflection of the structure. As can be seen the deflection of the strain gradient theory was lower than couple stress and the deflection of the couple stress was lower than classical one. In addition, by increasing the material length scale parameter, the amplitude of the system will be reduced. Furthermore, by considering CC boundary condition, the maximum amplitude decreases and the frequency is increased. Beam the geometry of the embedded micro cylindrical shell with radius, R, length, L, and thickness h. The structure is reinforced by FG-CNTs and is subjected to harmonic load. The structure is made from Poly Methyl Methacrylate (PMMA) with the constant Poisson's ratios of vm=0.34, temperature-dependent thermal coefficient of $\alpha m=(1+0.0005\Delta T)\times 10–6/K$, and temperature-dependent Young moduli of Em=(3.52–0.0034T) GPa in which T=T0+ΔT and T0=300 K (room temperature) (Madani et al. 2016). The effect of distribution type of CNT on the frequency response of the structure is shown.

Audience Take Away Notes

- Sandwich structures can be used in different industries such as aerospace, aircraft, automobile and etc due to high strength and low weight with respect to traditional materials
- One of the important ways for control of the sandwich structures, is using piezoelectric materials since in these materials, the structure subjected to mechanical forces can produces the electric field and vice versa
- The mathematical modeling of nanocomposite structures and the pursuit of numerical solutions represent a pivotal frontier in materials science and engineering. Nanocomposites, characterized by the incorporation of nanoscale reinforcements into a matrix material, exhibit unique mechanical, thermal, and electrical properties, offering a broad spectrum of applications in various industries
- The intricate interplay of nanoscale phenomena demands advanced mathematical models to

accurately capture the behavior of these structures under different conditions. The development of robust numerical solutions is essential for predicting and understanding the complex responses of nanocomposite materials

- This field not only explores the fundamental principles governing nanocomposite behavior but also addresses practical engineering challenges. As researchers delve into this subject, they contribute to the advancement of innovative materials with tailored properties, influencing the design and optimization of nanocomposite-based technologies across diverse domains, including aerospace, electronics, and healthcare
- The importance of this research lies in its potential to unlock new frontiers in material science, enabling the creation of advanced materials with enhanced performance characteristics and expanded applications

Biography

Maryam Shokravi received his PhD. degrees from University of Kashan in the field of mechanical engineering. She spent her sabbatical period at Northeastern University in Boston, USA. She has an extensive teaching experience, having served as a faculty member at Buein Zahra Technical University. Her courses taught include Strength of Material, Statics, Vibration, and dynamic analyses of various structures. Maryam has received several honors and awards. Maryam has an impressive list of publications in reputable journals and conferences, covering topics such as vibrations, buckling, and dynamic analyses of various structures, including nanocomposites, sandwich plates, and cylindrical shells.

Michael I. Tribelsky
Faculty of Physics, Lomonosov Moscow State University, Moscow, Russia

The poynting vector field singularities

A brief review is given of recent achievements in classifying singular points of the Poynting vector patterns in electromagnetic fields of complex configuration. The deep connection between the topological structure of the force lines pattern and the law of energy conservation, the symmetry of the problem, and the dimension of the space has been unveiled.

Audience Take Away Notes

- The results may be used as grounds for developing new nanotechnologies and metamaterials
- The discussed results are interesting both from an academic viewpoint and for practical applications
- Though the discussed results are not directly related to technological processes, they open the door to new technologies

Biography:

Prof. Tribelsky received his MS from Lomonosov Moscow State University in 1973, a PhD from Moscow Institute of Physics and Technology in 1976, and a Dr. of Sci. (habilitation) from Landau Institute in 1985. He received numerous national and international awards: Leninsky Komsomol Prize (1979); COE Professorship, the University of Tokyo (2006, 2008) and Kyushu University (2007), Japan; Honorary PhD, Yamaguchi University, Japan (2016), etc. Presently, his interest lies in subwavelength optics. He is the author of several books, book chapters, review articles, and more than 100 research papers. See for more details. https://polly.phys.msu.ru/en/labs/Tribelsky/ for more details.

Mohamed Abdelhedi* and Chedly Abbes
Earth ciences department, Laboratory of GEOMODELE (LR16ES17), Faculty of Sciences of Sfax, Tunisia

Ultrasonic velocity as a novel geophysical method for high-quality aggregate exploration

Estimating the quality of rock aggregates is crucial for various construction and infrastructure projects, yet traditional methods are often labor-intensive and designed for the final product rather than the raw rock material. Standard mechanical tests, such as abrasion and fragmentation resistance, are time-consuming and require intricate laboratory procedures. These conventional methods not only delay the assessment process but also involve substantial operational costs.

In this innovative study, we introduce a ground breaking non-destructive ultrasonic technique to characterize the mechanical strength of carbonate rock aggregates. This technique specifically targets the prediction of mechanical performance indicators commonly measured by the Los Angeles (L.A.) and Micro-Deval (M.D.E.) tests. By employing ultrasonic velocity measurements, this method offers a rapid, efficient, and cost-effective alternative to traditional testing.
Our research involved 11 carbonate rock samples, for which we determined porosity, density, and the L.A. and M.D.E. coefficients. Prior to these determinations, we conducted ultrasonic measurements on the samples using a longitudinal P wave with a frequency of 55 kHz. The results of our regression analysis revealed a strong linear correlation between ultrasonic velocity and the L.A. and M.D.E. coefficients, highlighting the method's predictive accuracy.

The findings underscore the potential of this ultrasonic method to predict mechanical performance accurately, offering a reliable alternative to the laborious traditional tests. This technique not only enhances the early-stage quality estimation of rock aggregates during quarry prospection but also provides significant economic benefits by reducing time and resource expenditure. The adoption of ultrasonic velocity measurements can streamline the production process, ensuring high-quality output from the outset and minimizing the need for extensive laboratory work.

Moreover, the versatility of ultrasonic techniques extends beyond carbonate rocks, suggesting potential applications in various geological settings and types of aggregates. By demonstrating the wide-ranging effectiveness of ultrasonic techniques in predicting aggregate quality, this paper sets the stage for their broader adoption in the rock aggregate industry. This method promises to revolutionize the field with its efficiency and precision, ultimately leading to more sustainable and economically viable mining practices.

Audience Take Away Notes

- The relationship between ultrasonic velocity and mechanical strength indicators like L.A. and M.D.E. coefficients
- Methods for implementing ultrasonic testing in the early stages of quarry prospection

- The cost-effectiveness of ultrasonic methods compared to traditional mechanical tests
- Quarry operators and engineers can apply these methods to streamline operations, reduce costs, and improve the accuracy of quality assessments in the field
- The method provides a more accurate prediction of mechanical properties, leading to better quality control and more reliable products
- This method provides a new avenue for research in geophysical techniques and material characterization, allowing for the exploration of innovative applications and improvements
- The technique's applicability to various rock types and geological settings broadens its usefulness across different sectors of the construction and mining industries

Biography:

Dr. Mohamed Abdelhedi studied Earth Sciences at faculty of sciences of Sfax, Tunisia, and earned his PhD in Earth Sciences. With over nine years of experience teaching at the primary level and one year at the Faculty of Sciences of Sfax, his research focuses on ultrasonic techniques in mining exploration, the mechanical behavior of rocks, and AI-based predictive models using Python. He has published several research articles and regularly reviews scientific manuscripts. Dr. Abdelhedi also worked as an NDT inspector for five years and holds ASNT Level 2 certification in various non-destructive testing methods.

Mohammad Al-Ilani[1*], Yehya Al Temsah[2], Yumun Al Rawi[2]
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Effect of impact load on posttension slabs reinforced with fiber Reinforced Polymers (RFP), using numerical analysis

With increasing pressures on cities and urban areas there is a growing demand to expand residential areas and infrastructure into rugged terrains such as mountains. This process poses unique challenges such as unstable terrain, landslides, and exposure to natural disasters that may cause an impact load on structures. Researchers stated that Impact loading on RC Slab gives rise to a strain rate influence on strength, stiffness, ductility and failure mode. Fewer researchers studied their impact on prestress-concrete reinforced with steel rebar. This study investigates the response of post-tension slab with fiber glass as a reinforcement material subjected to impact load. The use of fiber glass offers unique properties including high strength-to-weight ratio, high stiffness and oxidation and moisture resistance, making it a promising alternative to traditional reinforcement materials like steel. The findings of this study will contribute to advancing the understanding of the behavior of post-tensioned slabs reinforced with fiber glass rebars under impact loading, providing valuable insights for the design and construction of resilient and sustainable structures in civil engineering applications. A comparison is done among a traditional RC Slab with two post-tension slabs. Three models are presented. The first one is a RC slab with a thickness of 320 mm. The second one is a PT Slab with 250 mm thickness and reinforced with steel rebars. While the third one is a PT slab with the same thickness reinforced with fiber glass rebars. All slabs have the same planar size 3m x 6m. the three slabs are exposed to an impact load of 605 Kg from a reinforced concrete block dropped vertically from an exact height (20m) using a topographical system. The numerical analysis will help to determine the advantages and limitations of using FRP rebar reinforcement over conventional steel in PT slabs in terms of many parameters like deformation, crack patterns, and the overall strength.

Audience Take Away Notes

- The audience will gain insight into the unique properties of fiberglass as a reinforcement material, including its high strength-to-weight ratio, stiffness, and resistance to oxidation and moisture
- This knowledge will help engineers and designers in choosing appropriate materials for constructing resilient structures in challenging environments
- Faculty members can incorporate these findings into their curriculum to teach students about advanced materials in civil engineering

Biography
Mohammad Al-Ilani studied Civil and Environmental Engineering at Beirut Arab University and graduated as MS in 2018. He is following his PhD degree in civil and environmental engineering at the same institution. He is Founder and Manager for The Line for engineering and contracting. He has published more than 5 Publications (Effect of Successive Impact Loads from a Drop Weight on a Reinforced Concrete Flat Slab, Comparative study of modeling methods used to simulate initial stresses in prestressed beams towards manual analysis, Effect of Successive Impact Loads from a Drop Weight on a Reinforced Concrete Flat Slab...).

Musa'ab Ejaz[1*], Nabihah Sallih[1], Tang Tong Boon[2]

[1]Department of Mechanical Engineering, Universiti Teknologi PETRONAS, Seri Iskandar 32610, Perak, Malaysia

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Broadband sound attenuation of shape memory polymer with triangular-honeycomb unit cell metamaterial structural design

Periodic lattice structures using metamaterial design have gained significant research interest recently for elastic and acoustic wave attenuation applications. This study incorporates a triangulan reentrant honeycomb unit cell design combining Bragg scattering and local resonance mechanisms into a lattice structure to attenuate sound waves. Sound absorption coefficient and transmission loss were characterized using an impedance tube to investigate the effects of different thicknesses, cell arrangements, and direction of cell opening, for unit cells integrated into 3-D printed lattice structures. A peak sound absorption coefficient of approximately 0.96 was achieved when adopting a combination of different mechanisms, and retention of high sound absorption across the frequency band is also shown. Al transmission loss of 12-13 dB was achieved using this metamaterial design. Based on the results attained in this study, a triangular reentrant honeycomb metamaterial design is proposed to be adopted for acoustic noise-absorbing and selective frequency filtration applications.

Audience Take Away Notes

- Application of acoustic metamaterial design and lattice structures
- Integration of wave attenuation mechanisms into smart materials (shape memory polymers)
- Performing selective frequency filtration using intricate structural designs
- Compact metamaterial design can be readily adopted for various noise blocking applications
- High values of sound absorption coefficient achieved (a=0.96) would allow this acoustic metamaterial structure to be used in high Sound Pressure Level (SPL) environments

Biography

Musa'ab Ejaz is a PhD student in the Department of Mechanical Engineering at Universiti Teknologi PETRONAS (UTP). He earned his Master of Engineering in Mechanical Department from Lehigh University Pensylvania, USA. His research interests include acoustic metamaterials, noise control engineering, and vibroacoustics. He is currently working on using acoustic metamaterial lattice structures with Shape Memory Polymers (SMPs) materials for selective frequency filtration and their applications.

Nacro. A*, P. Karamian, S. Lemaitre
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Multi-scale modelling and simulation of high-contrast composite materials: Second-order gradient theory

This paper provides expressions for the tensors A0,0, B0,1, C0,0, and D0,0 for composite materials within the framework of second-order gradient theory. Numerical simulations using the modified Green's kernel accelerated scheme algorithm have been performed coupled with the MPI/Open MP library to optimize computation time cost. The 3D numerical simulations have been addressed for 3 different geometries, for which numerical values of the tensors, the computation times, and their classifications have been performed.

Keywords: Modelling, simulation, composite materials, high contrast, second-order gradient.

Biography:
My name is Alioune NACRO, I'm 28 and I'm in my third year of a PhD in solid mechanics, mechanical engineering, production engineering, civil engineering and transport. My thesis topic is multi-scale modeling and simulation of high-contrast composite materials: 2nd-order gradient theory.I work in the Nicolas Oresme mathematics laboratory at the University of Caen, in the Modelling and Applications team under the supervision of Dr Philippe KARAMIAN. I have a double engineering degree in mechatronics and mechanics.

Nasimuddin*, Michael Yan-Wah Chia
Institute for Infocomm Research, A*STAR, Singapore

Reconfigurable antenna structures using tunable materials

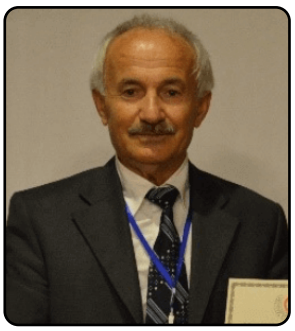
The integration of tunable materials in reconfigurable antennas has been instrumental since the inception of microwave/mmWave technology. These materials, including phase shifters, resonators, and antennas, play a crucial role in applications demanding Radiofrequency (RF) signal filtering, beamforming, and beam-steering. The emergence of wireless communications with wider bandwidth in 5G systems, satellite systems, and innovative radar systems has amplified the need for adaptability in frequency, radiation pattern, and polarization, marking a new era in wireless technology.

As operating frequencies extend into the millimeter-wave range and beyond, conventional RF/microwave tunable components such as Micro-Electromechanical System (MEMS) switches, PIN diodes, ferrites, and ferroelectric films face performance degradation, increased fabrication complexity, and elevated costs. In response, liquid crystals emerge as a promising solution due to their attributes, including bias-based continuous dielectric constant tuning, lower dielectric constants, adequate losses, low dispersion, and potential cost-effectiveness. This presentation provides a comprehensive summary of tunable and liquid crystal materials, emphasizing key application-relevant properties, characterization techniques, and performance metrics, especially in the spectrum above 1 GHz. Recommendations for material selection in various RF/microwave/mmWave applications will be discussed, along with insights into observed experimental discrepancies and their potential sources. A reconfigurable microstrip antenna leveraging liquid crystal technology will be introduced for electronically switching between linear and dual-sense circular polarization. The antenna comprises a square patch radiator with a single feed and a liquid crystal cavity. In this innovative design, liquid crystal cavities are strategically integrated into the substrate along diagonal lines, allowing the utilization of parasitic small patches for biasing and facilitating seamless switches between linear and circularly polarized radiations.

The ongoing progress in electronic technology and material science presents an exciting opportunity to design reconfigurable wireless communication devices that are not only variable frequency and flexible but also energy-efficient. The presentation delves into the exploration of liquid crystal materials in their dielectric constant function of biasing voltage for designing reconfigurable antennas. Emphasis is placed on the controlled reconfiguration of frequency response and beam steering through biasing voltage on tunable material-based antenna structures. Specific examples of reconfigurable antennas based on liquid crystals, such as leaky-wave antennas, array antennas, and circularly polarized antennas, will be discussed in detail, providing valuable insights into their applications and potential advancements in the field.

Biography

Dr. Nasimuddin (M'2003-SM'2009) received his B.Sc. in 1994 from JMI, India, and his M.Tech. and Ph.D. in 1998 and 2004, respectively, from DU, India. Dr. Nasimuddin has worked as a Senior Research Fellow (19992003) at DU, India. He has worked as an APD Research Fellow (2004-2006) at Macquarie University, Australia. Currently, he is working as a principal scientist at the Institute for Infocomm Research, A*STAR, Singapore. He has published 230 journal/conference papers and 3 granted patents on microstrip-based microwave antennas/components. He has edited two books, contributed a chapter, and ranked in the top 2% of World Scientists in 2023.



Osman Adiguzel
Department of Physics, Firat University, Elazig, Turkey

Shape memory effect and diffusionless phase transformation in shape memory alloys

Shape memory alloys take place in a class of adaptive structural materials called smart materials by exhibiting a peculiar property called shape memory effect and superelasticity with the recoverability of two shapes at different conditions. Shape memory effect is initiated with thermomechanical treatments on cooling and deformation and performed thermally on heating and cooling, with which shape of the material cycles between original and deformed shapes in reversible way. Deformation in the low temperature condition is plastic deformation, with which strain energy is stored in the materials and released on heating by recovering the original shape. This phenomenon is governed by the thermal and mechanical transformations, thermal and stress induced martensitic transformations. Thermal induced martensitic transformations occur on cooling with cooperative movement of atoms in <110> -type directions on a {110}-type plane of austenite matrix, along with lattice twinning reaction and ordered parent phase structures turn into the twinned martensite structures. The twinned structures turn into detwinned martensite structures with deformation by means of stress induced martensitic transformations. Superelasticity is performed in only mechanical manner with stressing the material and releasing in the parent austenite phase region, and shape recovery occurs instantly upon releasing, by exhibiting elastic material behavior. Atomic movements are confined to the nearest atom distances, atomic neighborhoods do not change, and martensitic transformations have diffusionless character. Superelasticity is performed with stressing and releasing the material in elasticity limit at a constant temperature in parent phase region, shape recovery occurs instantly upon releasing, by exhibiting elastic material behavior. Superelasticity is performed in non-linear way, and loading, and releasing paths are different at the stress-strain diagram, and hysteresis loop refers to the energy dissipation.

Superelasticity is also result of stress induced martensitic transformation and ordered parent phase structures turn into the detwinned martensite structures with stressing. Lattice twinning and detwinning reactions play important role at the transformations.

Copper based alloys exhibit this property in metastable beta-phase region. Lattice twinning is not uniform in these alloys and cause to the formation of unusual complex layered structures. The layered structures can be described by different unit cells as 3R, 9R or 18R depending on the stacking sequences on the close-packed planes of the ordered lattice. The unit cell and periodicity are completed through 18 layers in direction z, in case of 18R martensite, and unit cells are not periodic in short range in direction z.

In the present contribution, x-ray diffraction and Transmission Electron Microscopy (TEM) studies were carried out on copper based CuZnAl and CuAlMn alloys. X-ray diffraction profiles and electron diffraction patterns exhibit super lattice reflection. X-ray diffractograms taken in a long-time interval show that diffraction angles and intensities of diffraction peaks change with the aging duration at room temperature. This result refers to the rearrangement of atoms in diffusive manner.

Keywords: Shape Memory Effect, Martensitic Transformation, Thermoelasticity, Superelasticity, Twinning, Detwinning.

Audience Take Away Notes

- Shape memory alloys are functional materials, shape memory effect is multidisciplinary subject, audiences are from different disciplines. Therefore, usually I introduce the basic terms and definition related to this phenomenon at the beginning of my Talk and introduce the experimental results obtained in shape memory alloy samples. So, audiences can gain elementary knowledge on shape memory phenomena

Biography

Dr. Adiguzel graduated from Department of Physics, Ankara University, Turkey in 1974 and received PhD- degree from Dicle University, Diyarbakir-Turkey. He has studied at Surrey University, Guildford, UK, as a post-doctoral research scientist in 1986-1987, and studied on shape memory alloys. He worked as research assistant, 1975-80, at Dicle University and shifted to Firat University, Elazig, Turkey in 1980. He became professor in 1996, and he has been retired on November 28, 2019, due to the age limit of 67, following academic life of 45 years. He published over 80 papers in international and national journals; He joined over 120 conferences and symposia in international and national level as participant, invited speaker or keynote speaker with contributions of oral or poster. He served the program chair or conference chair/ co-chair in some of these activities. In particular, he joined in last six years (2014-2019) over 60 conferences as Keynote Speaker and Conference Co-Chair organized by different companies. Also, he joined over 120 online conferences in the same way in pandemic period of 2020-2022. He supervised 5 PhD- theses and 3 M. Sc-theses. Dr. Adiguzel served his directorate of Graduate School of Natural and Applied Sciences, Firat University, in 1999-2004. He received a certificate awarded to him and his experimental group in recognition of significant contribution of 2 patterns to the Powder Diffraction File–Release 2000. The ICDD (International Centre for Diffraction Data) also appreciates cooperation of his group and interest in Powder Diffraction File.

Raj Mukhopadhyay[1*], Carrie A McDonough[1], David V P Sanchez[2], Hassan Nawaz[2]

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Synthesis and characterization of modified mineral-biochar composite and its application for removing perfluorooctanoic acid from water

Per-and Polyfluoroalkyl Substances (PFAS) are a large group of anthropogenic compounds known as 'forever chemicals' due to their extremely persistent nature which makes them difficult to remove from the environment. Perfluorooctanoic Acid (PFOA), one of the most well-studied PFAS, is widespread in the environment and known to be toxic to wildlife and humans. The US EPA has set a Maximum Contaminant Level (MCL) of PFOA in drinking water at 4ng/L. Therefore, it is urgently required to remove PFOA from water. There are many technologies involved in removal of PFOA from water such as advanced oxidation processes, photocatalysis, UV-Fenton reaction, and adsorption processes. However, most of these processes are expensive and energy intensive. On the other hand, adsorption is simple, easy, efficient and widely used in recent years. Conventional adsorbents such as granular activated carbon, io exchange resins, organoclays and iron oxides have been used to remove PFAS from water but most of them suffer from low adsorption capacity, slow rate, high desorption capacity and energy intensive synthesis process. Hence, there is a need to develop inexpensive and efficient adsorbents to remove PFOA from aqueous systems using naturally available minerals and biowaste. In this study, we synthesized Wood Chip Biochar (WCBC) through pyrolysis reaction at 500 using wood biomass and prepared Montmorillonite (MMT) Clay-Biochar (WCBC-MMT) in 50:50 ratio using ball mill. The composite was further modified with a long-chained surfactant (di (hydrogenated tallow) dimethylammonium chloride) on the basis of cation exchange capacity of the composite (27.2 cmol (p+)/ kg) and it was renamed as modified clay-biochar (MWCBC-MMT) composite. The modified mineral-biochar composite was synthesized successfully and confirmed through X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM) and Fourier-Transformed Infrared Spectroscopy (FTIR). The specific surface area of MMT, WCBC, WCBC-MMT composite and MWCBC-MMT composite was 242.3, 364.1, 315.7, and 61.4 m2/g. The kinetic experiment suggested that the MWCBC-MMT composite reached PFOA sorption equilibria within 2 h at initial PFOA concentration of 20mg/L. The maximum potential of PFOA adsorption was 143.35 mg/g for MWCBC-MMT composite which was comparatively better than unmodified MMT, raw WCBC and WCBC-MMT composite. The modified clay-biochar composite adsorbents had better PFOA sorption capacity due to its porous nature and enhanced functional groups present on the surface. The mechanism of interaction between PFOA and the MWCBC-MMT composite was predominantly hydrophobic. The pH experiment at 20mg/L initial concentration revealed that PFOA adsorption was more effective at low pH between 2 and 4 and it decreased when pH was increased to 8 and 10. This phenomenon can be described by electrostatic attraction of negatively charged PFOA to the positively charged sites on the adsorbent at low pH. However, the desorption was 60% at first (24 h=1 cycle) and reached up to 99% after 3 cycles. This study suggests that surfactant-modified biochar-clay composite can be an efficient adsorbent for PFOA removal from water and warrants future research to evaluate the application and performance of the material under natural wastewater conditions.

Audience Take Away Notes

- The audience of this presentation would get detail information on how to design an inexpensive adsorbent using naturally available biowaste and mineral to remove extremely persistent contaminant like Perfluorooctanoic Acid (PFOA)
- This study will definitely smoothen the job of engineer to design an efficient adsorbent material without spending high energy, cost and labor for wastewater remediation
- This study shows a way forward to practically remediate PFAS contaminated wastewater and soil using the inexpensive surfactant modified wood chip biochar-mineral composite
- This study would also help the faculty to further expand their research work in the area of mineral adsorbent which can be easily implemented by the wastewater treatment plant stakeholders and the land reclamation experts to remediate PFAS contaminated soil

Biography

Dr. Raj Mukhopadhyay is a Fulbright-Nehru Postdoctoral fellow at Department of Chemistry, Carnegie Mellon University, Pittsburgh. He received his PhD in soil science and Agricultural Chemistry from Indian Agricultural Research Institute, New Delhi, India in 2018. He joined as Scientist at Central Soil Salinity Research Institute, Karnal-India after completion of PhD. His research is focused on environmental engineering, particularly wastewater remediation using engineered materials. He published 22 international peer-reviewed publications.

Robert Buenker
Princeton University, Germany

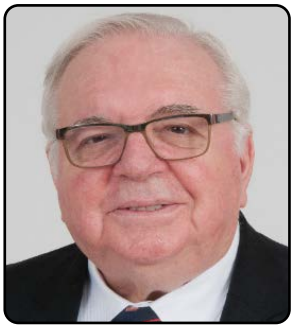
The failure of both einstein's space-time theory and his equivalence principle and their resolution by the uniform scaling method

The Lorentz Transformation (LT) makes three predictions which are not consistent with one another: Lorentz-FitzGerald Length Contraction (FLC), Time Dilation (TD) and light-speed equality for observers in relative motion to one another. The LT also stands in violation of the Law of Causality because it fails to recognize that inertial clocks can never change their rate spontaneously. Einstein's Light-Speed Postulate (LSP) is shown to be unviable by considering a case in which a light source passes by a stationary observer at the same time that it emits a light pulse in the same direction. It is found that, in contradiction to the LSP, that the classical velocity (Galilean) Transformation (GVT) is applicable when two observers in relative motion deduce the speed of a light wave.

The Newton-Voigt transformation (NVT) is consistent with the Law of Causality because it assumes space and time do not mix. The NVT is nonetheless consistent with the Relativistic Velocity Transformation (RVT) and also with Einstein's mass-energy equivalence relation E=mc2. The ratio Q of clock rates for two inertial rest frames S and S' is required input for the NVT. Experimental data obey the Universal Time-dilation Law (UTDL) which states that the measured time Δt obtained by a inertial clock for a given event is inversely proportional to γ(v)=(1-v2c-2)-0.5v, where v is the speed of the clock relative to a specific rest frame referred to as the objective rest frame ORS. The value of Q when the clock of the observer in at rest in S while that of another observer is at rest in the object's rest frame S' is obtained from the UTDL as the ratio γ(v')/γ(v). The Uniform Scaling method considers Q to be a conversion factor between the units of time in the two rest frames. It is found that the conversion factors for all other physical properties are integral multiples of Q. Kinetic scaling of the properties insures that the laws of physics are the same in each inertial frame, as required by the RP. It is also pointed out that Einstein's Equivalence Principle (EP) fails to deduce the experimental fact that the wavelength of light is invariant to changes in gravitational potential. The Universal Scaling method uses a set of conversion factors for the effects of gravity that is analogous to those for kinetic scaling.

Biography

Robert J. Buenker born to Mr. and Mrs. Joseph F. Buenker in Dubuque, Iowa. He received B.S. Degree (Maxima Cum Laude)in Mathematics and Chemistry from Loras College, Dubuque, Iowa and Ph.D. Degree in Chemistry from Princeton University, Princeton, New Jersey. He worked as Assistant Professor of Chemistry, University of Nebraska, Lincoln, Nebraska. Associate Professor of Chemistry, University of Nebraska, Lincoln, Nebraska. Professor of Chemistry, University of Nebraska, Lincoln, Nebraska Wissenschaftlicher Rat und Professor, Universität Bonn, Germany. Professor of Theoretical Chemistry, Bergische Universitat-Gesamthochschule, Wuppertal, Germany. Adjunct Professor, Department of Chemistry, North Carolina State University, Raleigh, NC, USA. Emeritus Professor of Theoretical Chemistry, Bergische-Universitat, Wuppertal, Germany. Adjunct Professor, Department of Physics, University of Georgia, Athens, GA, USA. Awards: Senior U.S.Scientist Award of the Humboldt Foundation for research and teaching at the University of Bonn, Germany.



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Adverse events following transvaginal polypropylene mesh implantation to treat pelvic floor disorders: An explanatory study of explanted devices

Transvaginal Transvaginal polypropylene meshes used to treat pelvic floor disorders have been a significant concern in recent years due to adverse events. There is still considerable uncertainty about the causes of these complications. We aim to identify histological patterns that could contribute to adverse events associated with polypropylene meshes in the surgical treatment of POP and SUI.

Eight explants were retrieved from seven patients (pelvic organ prolapse: four; stress urinary incontinence: three). Indications for explantation included vaginal mesh exposure (five), bladder mesh exposure (one) and recurrent prolapse (one). The explants were processed for histological investigations in scanning electron microscopy, light microscopy after different stainings (hematoxylin-eosin, Masson's trichrome, Weighert, red picrosirius) and transmission electron microscopy.

Eye naked observation revealed multiple small tissue fragments and chunks interspersed with fabrics, with loose polymer threads observed at the edges. Scanning electron microscopy showed varying levels of tissue encapsulation: from proliferative tissue in the absence of bacterial colonization to inconsistent debris in the presence of infection. Damage to the polypropylene filaments included perpendiculars cracks, uplifted oxidized layers, and longitudinal fragmentation. Light microscopy identified inflammatory cells along the polypropylene surface, surrounded by concentric scar tissue layers primarily composed of collagen. The fibers appeared stretched without noticeable undulation. In cases of bacterial colonization, the encapsulation was made up of cellular debris. Transmission electron microscopy confirmed the absence of sinusoidal collagen fibers. In the absence of bacteria, the filaments were distinctly individualized and aligned in parallel with regular banding. Bacterial colonization was associated with the lysis of encapsulation, though individual collagen filaments retained their structure.

The polypropylene fibers exhibited a lack of biostability, likely to exacerbate a chronic inflammatory response. Mishandling of the polypropylene mesh might further accelerate its degradation. In the absence of bacteria, scar tissue formation consisted of stretched collagen fibers, which were well-defined and exhibited extensive stretching. When implanted, the polypropylene mesh is unable to form a soft bio-reconstruction. Ideally, such a device should be encapsulated by parallel sinusoidal collagen fibers with regular banding to prevent contraction and resist bacterial hospitality.

Audience Take Away Notes

- While polypropylene meshes improve the quality of life for patients with pelvic organ prolapses and stress urinary incontinence, concerns about their biocompatibility remain
- After encapsulation, the polypropylene threads become encased in scar tissue, which can shrink as the collagen bundles contact. If bacteria are present, the scar tissue undergoes gradual lysis and traps bacteria
- A smart material, resistant to biodegradation, with collagen encapsulation whose fibers demonstrate a sinusoidal morphology might be an answer to mesh shrinkage
- The presence of bacteria warrants exploring alternative treatments, such as bacteriophage therapy

Biography:

Professor Robert Guidoin is a professor of surgery (biomaterials) at Laval University, Québec, Canana, and an international leading expert in biomaterials. He obtained university degrees in Chemistry at University of Nantes and came to Laval University in 1971 after a post-doctoral training at the FAU Erlangen-Nurnberg. Further to a specific training at Strathclyde University, he was appointed Assistant Professor at Laval University in 1976 and became Full Professor in 1986. He made important contributions in cardiovascular implants and other medical devices. He is Fellow, Biomaterials Science and Engineering, and is Honorer Faculty at several unversities in China.

Dr. Saheli Biswas*, Dr. Gurpreet Kaur, Mr. Sathia Aruliah, Dr. Sarbjit Giddey

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Material challenges with proton conducting ceramics for intermediate temperature hydrogenation/dehydrogenation applications

Fuel cells and electrolyzers based on ceramic materials have become an integral part of power↔X technology. Amongst the different categories of ceramic materials, proton-conducting ones exhibit superior ionic conductivity in the intermediate temperature range of 400 to 700°C. Such a broad temperature window expands the scope of integration with downstream/industrial processes such as methane generation (Sabatier process) and ammonia synthesis (Haber Bosch process) since the heat produced due to exothermic reactions can be utilized within the system. Further applications include dehydrogenation reactions like ammonia cracking and dehydrogenation of methylcyclohexane. Additionally, the broad temperature range expands the choice of materials that can be used as electrodes.

State-of-the-art proton-conducting ceramic materials are barium and strontium-based doped zirconates and cerates that require an incredibly high sintering temperature (>1500^{0}C) to achieve fully densified electrolyte membranes to prevent gas crossover. However, such high-temperature sintering limits the choice of materials, especially ceramic-metallic composites (cermets) that are conventionally used as fuel electrodes for ceramic material based fuel cells and electrolyzers. On the other hand, low-temperature sintering leads to insufficient densification that results in lower ionic conductivity and limited hydrogen flux, which is currently the main challenge of scaling up this technology. It is suggested that incorporation of transition and alkali metal oxides as sintering additives can induce Liquid Phase Sintering (LPS), offering an efficient method to facilitate densification of these proton conducting ceramics. However, current research underscores that incorporating these sintering additives may lead to adverse secondary effects on the ionic transport properties of these materials since the concentration and mobility of protonic defects in a perovskite are highly sensitive to symmetry change. This presentation aims to address these challenges and discusses the strategies being adopted to develop proton-conducting ceramic materials that can achieve adequate densification at lower sintering temperatures.

Audience Take Away Notes

- Solid state electrolyte, ionic conductivity, proton transference, densification, grotthuss mechanism
- This presentation aims to discuss issues like how metal oxides can help reduce the sintering temperature needed to achieve a fully dense ceramic electrolyte. We also discuss how sintering profile can cause thermal and mechanical stress in ceramic samples leading to cracks. These are broader concepts that can be applied not only to solid state electrolysers but other areas where ceramics are being used
- People working on ceramic processing will highly benefit from this presentation. They will get a broader understanding of how ceramic processing is affected by synthesis techniques (solid state reaction, sol-gel, co-precipitation), sintering profiles (temperature, heating/cooling ramp rates,

dwell times), etc. These understandings can be directly applied in their research work.

- This research topic can be used by Material Science Engineering as well as Chemical Engineering departments to expand the research or teaching
- It provide a practical solution to a problem that could simplify or make a designer's job more efficient
- It will enhance design accuracy and offer new insights for problem-solving
- List all other benefits.
    - A deeper understanding of
    - liquid phase sintering can help achieve a fully dense ceramic electrolyte
    - how sintering profile can cause thermal and mechanical stress in ceramic samples leading to cracks
    - Grotthuss mechanism of proton transport in proton conducting electrolytes
    - How ceramic composition can affect ionic transport as well as proton transference
    - how ceramic processing is affected by synthesis techniques (solid state reaction, sol-gel, co-precipitation), sintering profiles (temperature, heating/cooling ramp rates, dwell times)

Biography

Dr. Saheli Biswas is a postdoctoral research fellow at CSIRO Australia, working on green hydrogen production via high-temperature solid oxide technology and commercialization. Her expertise lies in renewable energy, electrochemical technologies for green fuel production and decarbonization, product commercialization, ceramic materials development, heterogeneous catalysis, coating formulation and techniques, fuel cell and electrolyzer testing, data acquisition, and numerical analysis. She has published more than 25 scientific papers and holds 2 patents. She holds a PhD in Chemical Engineering from Monash University, Australia (2019-2022), M.S. in Chemical Engineering from Lehigh University, USA (2014-2017), and B.Tech in Chemical Engineering from India.

Prof Samuel Chisa Dike* & Dr Ethel Woha & Chinwenwo Wigwe
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Deploying nanotech for sustainable energy transition in Nigeria

Nanotech is a buzz word for modern technological advancement and breakthroughs globally. This is due to its application and adoption in sectors where conventional technology could not achieve much progress. Such sectors include but not limited to Energy, Environment, Health care Biotechnology among others. Energy is the engine that drives modern development globally. However, energy development and uses had been seriously implicated in the orgy of Environmental pollution, Biodiversity depletion and Climate degradation. It is on account of this that the global community seeks for a just energy transition from the highly carbonised energy regime to a more sustainable energy governance. Nigeria's economic development and advancement over the years hinged on energy resource development, particularly the petroleum sector. Again, the development of this sector in Nigeria had never been without some negative environmental footprints due to bad resource governance. Nigeria equally seeks to transit from this ugly past to a more robust energy use and development which is not only sustainable but anchored on a new set of technology that is more efficient, and smart .Nanotech with all its innovations and trappings promises to be useful and handy for Nigeria if the science ,technology and application of Nanotech can be aggressively pursued through a deliberate injection and development of Nano legal and regulatory framework at a more commercial level. This paper seeks to examine the hindrances to the commercial deployment of Nanotech for meeting Nigeria's quest for a sustainable energy development in the light of a just energy transition scenario advocated globally.

Keywords: Nigeria, Nanotech, Sustainable, Energy, Just Transition & Commercial deployment

Sharda Sundaram Sanjay
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Specification of the surface of nanomaterials through functionalization

The functionalization of nanomaterial surfaces has led to a break through advancement in nanotechnology, especially in the pharmaceutical and biomedical sciences. The clinical results showed that adding specific chemical species to nanoparticles changed them into multifunctional particles with higher efficiency. Precisely designed, functionalized nanoparticles are finding applications as catalyst precursors, optical materials, sensor components, and many more. Functionalizing host molecules with inorganic/organic functional groups is an efficient way to create sophisticated materials that combine the optoelectronic and surface capabilities of the substrate with the molecular selectivity of the capping groups. Amino acids like lysine, polylysine, glycine, etc. can be functionalized onto gold nanoparticles to bind DNA more effectively and safely for the delivery of genes. This is accomplished by conjugating these particular chemical functional groups, which give nanoparticles unique surface locations with targeted molecule attachment for targeted functionalities. Functionalization on the surface It does three things to the nanoparticles: it attaches various organic and inorganic groups to them; it makes them more soluble so that hydrophobic species can be carried by them; and last, it permits a uniform dispersion of the nanoparticles in an organic matrix. Using any of the following techniques, surface functionalization can be completed: i) in situ functionalization, where the functionalization is done while the material is being synthesised; or ii) post-functionalization, when the functionalization is usually performed to inorganic nanoparticles that have already formed. Functional groups such as hydroxy, thio, amino, nitro, carboxy, or primary alkyl groups are commonly employed to modify surface functionality. The main forces for functionalization are hydrogen bond, ionic, nonionic, and van der Waals interactions.

Audience Take Away Notes

- The audience will learn about the functionalization of nanomaterials for various applications, specifically in pharmaceutical and biomedical sciences where the knowledge of solubility and toxicological problems has to considered for both human and environmental health
- This will undoubtedly assist the research fellows and other academics by offering a workable solution to their issues and will increase a conceptual idea or offer fresh data to help with a design issue
- This will definitely support other faculty members' research that they can use for their further studies or teaching
- This offers a workable solution to an issue that might streamline or improve the effectiveness of a designer's work

Biography

Sharda Sundaram Sanjay earned her M.Sc (Analytical Chemistry) and acquired D.Phil. degree from University of Allahabad, India. Working on: (i) mixed ligand complexes. and (ii) Synthesis, Characterization and functionalization of nanomaterials. She successfully Completed a major research project entitled, “Synthesis, characterization of functional Nano-particles with special reference to their stimulatory action on living cells and hormones”. She has authored 2 books

on Nanotechnology, many papers and book chapters published in National & International Scientific publications. She has been delivered many invited talks were delivered in National and International conferences, seminars, workshops and webinars organised by various national and Internationally reputed institutions. She is also a Life Member of many reputed scientific associations. She is Presently an Associate Prof. in Chemistry department of 'Ewing Christian College, An Autonomous PG College of University of Allahabad.

S. K. Bandyopadhyay
Retired Scientist, Variable Energy Cyclotron Centre, 6/2J, Naktala Road, Kolkata-700 047

Studies on multifunctional nanostructured materials

Multifunctional materials are of today's quest. Miniaturization, i.e. development of these materials in the form of nanomaterials is of primary need considering their application in devices. Moreover, if these are obtained in nanostructured form, they can bring wonders.

Recently, a we have adopted for developing multiferroic $BiFeO_3$ (BFO) with simultaneous antiferromagnetic, ferroelectric & ferroelastic behaviour in form of nanostructures like nanorods, nanowire etc. by employing Anodised Alumina (AAO) template with various pore sizes from 20nm with solution route followed by controlled vacuum filtration and sintering. Diameters of nanorods are in the range of 20-100 nm as observed by FESEM. Capacitance assayed by Cyclic Voltammetry (CV) and charge discharge processes reveals a very high value of specific capacitance of 450F/gm. Capacitance has been estimated by extrapolating the charge collected at the electrode to that at scanning rate of infinity which is relevant for the charge collected at the nanorods protruding out of the template. Charging and discharging times are quite constant over a large number of cycles. This large value of specific capacitance can be attributed to the nanostructure form of BFO nanorod. The high value of specific capacitance of BFO nanorods brings forth its use as electrode in storage energy devices. Also, a high value of polarization as well as a significant magnetic susceptibility are observed in multiferroic Bismuth Ferrite (BFO) in the form of nanorods protruding out. The high values of polarization and magnetic susceptibility are attributed to the structured form of BFO nanorods giving rise to the directionality. There is no leakage current in P-E loop examined at various fields and frequencies. Magnetocapacitance measurements reflect a significant enhancement in magnetoelectric coupling also.

We have also developed a variety of conducting polymer (like PANI, PEDOT etc.) and graphene based nanocomposites with a large value of specific capacitance for use as energy storage device. Low energy ion source available at VECC is a useful tool to develop various nanostructures like nanoripples, nanopillars etc. Some novel nanopillars of Ni have been developed using low energy ion beam irradiation.

Biography

S. K. Bandyopadhyay completed his Higher Secondary from Ballygunge Govt. High School in Kolkata under West Bengal Board of Sec. Education in 1971, (1st Division Ranked 30th). His B.Sc. (Chemistry Honours, Physics, Mathematics) from Presidency College in 1974, under Calcutta University (Results in 1975). In 1977 he obtained his M.Sc (Chemistry) from Indian Institute of Technology, Kanpur (1st class, Ranked 3rd). In 1978 he Joined Chemical Engg. Division, Bhabha Atomic Research Centre as Scientific Officer (SC) after his completion of 21st batch training School. He joined Variable Energy Cyclotrn Centre in 1982, also as a Scientific Officer (SC). His PhD (Physics) from Jadavpur University in 1998. Title of Thesis:"Charged Particle Irradiation Studies on Copper Oxide Superconductors". In 2000, he served as a Post Doctoral fellow at the Atomic Institute of Austrian Universities in Vienna.

Sylwia Wciślik
Kielce University of Technology, Aleja Tysiaclecia Panstwa Polskiego 7, 25-314 Kielce, Poland, Department of Building Physics and Renewable Energy, Faculty of Environmental Engineering, Geodesy and Renewable Energy

Effect of mono and hybrid nanofluids on contact angle and heat transfer rate

Nowadays, nanofluids are involved in thermal energy systems as heat transfer fluids. Wetting properties and contact angle measurements play a crucial role in evaporation processes and are closely related to pumping power and corrosion problems.

In this paper, the effect of nanoparticle addition on the wetting properties is discussed. TiO_2, ZnO, CuO and SiO_2 water and bio ethylene glycol based nanofluids are mixed together with various concentrations. The suspensions are prepared by two-step methods and their stability is checked by zeta potential analysis.

The contact angle, pH, viscosity, and z potential are measured throughout the liquid phase. The addition of a small percentage of nanoparticles notably changing the contact angle, pH, and viscosity of the examined nanofluid. The research is carried under atmospheric pressure and in a range of temperatures of 20-110°C. Moreover, the work proposes a new correlation that takes into account the influence of the contact angle of the nanofluid on the heat transfer coefficient. The presentation will also discuss various methods of imaging wetting, e.g. Young-Laplace, tangent, and ellipse methods, and available goniometric techniques.

The selection of appropriate methods and models to determine the contact angle must mainly consider the following: the thermal conditions of the experimental execution, i.e. temperature ranges, fluid type, and process dynamics. It is very important to ensure that the geometry and shape of the droplet are correctly mapped (as close as possible to the actual one). The digital goniometer measurement allows the use of at least five approximations of droplet shapes.

The results are also modelled and used for efficiency calculations of the plate heat exchange system in solar installation with nanofluids.

Audience Take Away Notes

- The audience will be able to calculate the heat transfer coefficient on the basis of the proposed correlation taking into account contact angle
- It allows to assess appropriate thermal conditions of thermal process for efficient operation
- This undoubtedly provides a practical solution to heat and cool transfer processes that could simplify and make a designer's job more efficient
- The results will be applied for modelling heat transfer in solar installations operated with nanofluids. Therefore, the research also improves the accuracy of a design and provides basic information on the efficiency of such systems

Biography

Dr. Sylwia Wciślik works for Kielce University of Technology, Poland, and received her PhD degree in 2014 at the same institution, where she has a position of assistant professor. Her dissertation treats droplet evaporation under a film-boiling regime. She is a laureate of, among others, Prof. Engel awards for research innovation. She carried out intensive research on nanofluids and contact angles. She has published more than 40 research papers.

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Multiscale modeling of advanced heterogeneous materials

Unlike many other fields in material science, the evolution of composites and nanocomposites to their anticipated level of importance in general significantly depends on the contributions from modeling and simulation. The most popular methods of analytical micromechanics are based just on a few basic concepts. The Effective Field Hypothesis (EFH) dates back to Poisson, Faraday, Mossotti, Clausius, Lorenz, and Maxwell (1824-1879). This concept of EFH (forming the first background of micromechanics, see for details) has directed the development of micromechanics (even if the term EFH was not used) over the last 150 years (daily and globally) and made a contribution to their progress incomparable with any other concept of analytical micromechanics. Only in 2010, the author suspends total domination of EFH in micromechanics by a proposal of a new (the second) General Integral Equation (GIE) forming, in fact, the second background of micromechanics called also Computational Analytical Micromechanics (CAM, the author term, see for details. CAM has been the most fundamental step in analytical micromechanics for the last 130 years after Lord Rayleigh (1892) proposed the first GIE. It offers opportunities for a fundamental jump in multiscale and multiphysics research with drastically improved accuracy of local field estimations (even to the point of correction of a sign in some points inside the inclusions), which is critical for advanced material development (especially for nonlinear modelling). Due to its generality, CAM is very flexible and based on physically clear hypotheses that can be modified and improved, if necessary, by incorporating modifying blocks exploiting a wide spectrum of linear and nonlinear numerical methods. Some particular versions of the CAM were analyzed for the wide class of static and dynamical, local and nonlocal (e.g. peridynamic), linear and nonlinear multiscale problems (thermoelasticity, thermoelastoplasticity, conductivity, piezoelectricity, strength, fracture, nonlinear elasticity, viscosity, creep and other) of composites and nanocomposites with deterministic (periodic and nonperiodic), random (statistically homogeneous and inhomogeneous, so-called graded) and mixed (periodic structures with random imperfections) structures in the bounded and unbounded domains, containing the coated or uncoated inclusions of any shape and orientation and subjected to the coupled or uncoupled, homogeneous or inhomogeneous external fields of different physical natures. CAM is an affordable, adaptable, robust, physics-based, and data-driven multidisciplinary design and optimization toolkit. CAM is presented as a fundamentally new blocked (or modular) structure [3] that is perfectly adapted for the joint development of CAM by teams of experts from different scientific areas (e.g. the block “peridynamics” and block “micromechanics”). Any knowledge inside one block is not required in another block. However, these opportunities of CAM can be realized only in the case of joint efforts of both computational micromechanic society and the analytical one as well as material science and physics societies.

Biography

Valeriy A. Buryachenko received his MS in Mathematics from M.V. Lomonosov Moscow State University, Moscow, USSR, his PhD in Material Science from the Chemical Production Engineering, Moscow, USSR; and his DSc degree in Mechanical Engng (Mechanics of Solids) from SP Timoshenko Institute of Mechanics (NAS of Ukraine, Kyiv, Ukraine). He is the author of 170 papers and two books mentioned above. His main achievement is the creation of CAM. He is the President of a small consulting company Micromechanics & Composites LLC. Before this, he worked in the leading Research centers and universities in the USA, Italy, Austria, and Germany.

Victor Ciupina[1,5*], Rodica Vladoiu[1,5], Gabriel C. Prodan[1], Corneliu Porosnicu[2], Veronica Satulu[2], Ecaterina Andronescu[3,5], Bogdan Vasile[3], Virginia Nicolescu[4]

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Nitrogen-doped Carbon/Titan/Carbon/Aluminium/Carbon/Silicon thin films: Synthesis by TVA technology and characterization

The goal was to create varied types of nanostructurated thin films using four materials of interest: graphite, titanium, silicon, and aluminum, with the inclusion of nitrogen, on the Si substrate, by Thermionic Vacuum Arc (TVA) technology. The thickness of the structures was 300 nm in the two cases: N-C/Ti/C/Al/C/Si multilayer film (34nm C, 66nm Ti, 35nm C, 65nm Al, 31nm C, 69nm Si) and N-C+Ti/C+Al/C+Si composite film (100nm C+Ti, 100nm C+Al, 100nm C+Si). For each type of samples there are some parameters varied: substrates temperature (Room Temperature, 200°C, 300°C, 400°C) and bias voltage applied on substrates, i.e., -400V. HRTEM images were use for structural analyze. The structure and properties of the films are highly dependent on the nitrogen content, where non-reactive depositions yield films consisting of understoichiometric TiCx, Ti, and silicide phases, with a hardness larger than of 10 GPa, depending by the nitrogen procentage. Ti-Si-Al-C-N thin films with high contents of Si and C, extend de limits of the two successfully applied ternary systems Ti-Si-N and Ti-C-N in the presence of aluminium. Nanoidentation measurements (Young modulus and Hardness) show: Hardness increases from 3.15GPa (N-doped C/Ti/C/Al/C/Si multilayer thin films) to 7.82GPa (N-doped- C-Ti/C+Al/C+Si Composite thin films).

SEM and EDX (Elemental composition) characterization studies show a dependence of the atomic percentage of the elements Ti, Si and Al on the substrate deposition temperature. XPS depth profiles reveal the atomic percentages of Si2p, C1s, Al2p, Ti2p and O1s. The tribology measurements show: minimum values of friction coefficient in the case of N-doped C+Ti/C+Al/C+Si composite thin films are larger compared with the minimum values in the case of N-doped Si/C/Al/C/Ti/C multilayer thin films. Electrical conductivity on the Ti-Si-Al-C-N films shows the increase of conductivity with the increase of the nitrogen content, explained by a thermally activated electric transport mechanism.

Biography

Professor Victor Ciupina is member of some profile societies: President of Physical Balkan Union (2009-2012); Physics Romanian; European Physics Society; Fellow of the Physics Institute in London; Romanian Material Science-Cristal Growth Society; Full Member of the Academy of Romanian Scientists. Distinctions/Honors/Official Functions: Dragomir Hurmuzescu prize of Romanian Academy for research 2005; Doctor Honoris Causa of State Medicine University in Odessa; Rector of "Ovidius" University of Constanta (2004-2012). Author of 450 scientific papers in the field of Condensed Matter Physics, 148 of them ISI quoted. Author of 8 books, 2 laboratory notebooks, 4 physics university compendia.

S. R. de Lima, D. G. Felipe, T. B. Serna, J. M. Oliveira, L. A. A. Teófilo, A. A. Andrade, V. Pilla*
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Photophysical evaluation of aqueous carbon dots synthesized from several raw materials for bioapplication

Fluorescent Carbon dots (C-dots) have been increasingly development with a wide range of bioapplications. The use of green synthesis, using raw materials such as seeds, flowers, and other carbon sources, has increased. These C-dots have potential in several bioapplications due to their biocompatibility, stability, relatively low cost, biodegradability, nontoxicity, and environmental friendliness. This work discussed the synthesis of C-dot using different carbon sources obtained from chitosan, seeds, and leaves of plants. Natural dyes were extracted from the leaves of Tradescantia pallida purpurea and annatto seeds in aqueous solutions and used as a carbon source for green synthesis. Natural dyes are pigments with different color possibilities, with various applications in healthcare, pharmaceutical, food processing, solar cell development, bioindicators, biomonitoring, and fungicide probes for fungi. Chitosan-based materials are nontoxic, ecological, biodegradable, biocompatible, and bactericidal. The fluorescence quantum yield (η) values are presented for green synthesized C-dots using spectroscopy and thermo-optical techniques. The value of η was determined by using the mode-mismatched pump-probe Thermal Lens (TL) technique. Fluorescence spectra and time-resolved fluorescence measurements corroborate the TL results. The photophysical results obtained for carbon dot-based materials will be compared with other C-dots reported in the literature, highlighting possible functional bioapplications.

Audience Take Away Notes

- Simplified Green Carbon Dots (C-dots) synthesis processes using plants, seeds, and other carbon sources as raw materials
- C-dots photophysical evaluation for fluorescence quantum yield and lifetime measurements
- Spectroscopic and photothermal techniques
- C-dots for functional bioapplications

Biography
Dr. V. Pilla studied Physics at the Universidade Estadual Paulista (UNESP). Received her PhD degree in Applied Physics Sciences from the Universidade de São Paulo (USP). Post-doctorate in Applied Physics at Universidade Federal de Pernambuco (UFPE), and Universidade de Campinas (UNICAMP). Post-doctorate in Physical Chemistry, and worked on new fluorescent nanomaterials for bio and environmental applications at Universidade NOVA de Lisboa. Since 2010 is a professor at the Federal University of Uberlândia (UFU). Has experience in physics, focusing on optical and spectroscopic properties of biomaterials, nanoparticles synthesis, and preparation of several biomaterials for potential bioapplications.

Vladimir G. Chigrinov

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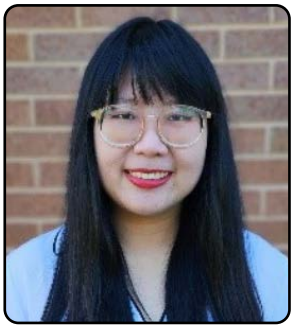
Azodye photoaligned nanolayers for liquid crystal: New trends

Photoalignment and photopatterning has been proposed and studied for a long time. Light is responsible for the delivery of energy as well as phase and polarization information to materials systems. It was shown that photoalignment liquid crystals by azodye nanolayers could provide high quality alignment of molecules in a Liquid Crystal (LC) cell. Over the past years, a lot of improvements and variations of the photoalignment and photopatterning technology has been made for photonics applications. In particular, the application of this technology to active optical elements in optical signal processing and communications is currently a hot topic in photonics research. Sensors of external electric field, pressure and water and air velocity based on liquid crystal photonics devices can be very helpful for the indicators of the climate change.

We will demonstrate a physical model of photoalignment and photopatterning based on rotational diffusion in solid azodye nanolayers. We will also highlight the new applications of photoalignment and photopatterning in display and photonics such as: (i) fast high resolution LC display devices, such as field sequential color ferroelectric LCD; (ii) LC sensors; (iii) LC lenses; (iv) LC E-paper devices, including electrically and optically rewritable LC E-paper; (v) photo induced semiconductor quantum rods alignment for new LC display applications; (vi)100% polarizers based on photoalignment; (vii) LC smart windows based on photopatterned diffraction structures; (vii) LC antenna elements with a voltage controllable frequency.

Biography

Professor Vladimir G. Chigrinov is Professor of Hong Kong University of Science and Technology since 1999. He is an Expert in Flat Panel Technology in Russia, recognized by the World Technology Evaluation Centre, 1994, and SID Fellow since 2008. He is an author of 6 books, 31 reviews and book chapters, about 317 journal papers, more than 668 Conference presentations, and 121 patents and patent applications including 36 US patents in the field of liquid crystals since 1974. He got Excellent Research Award of HKUST School of Engineering in 2012. He obtained Gold Medal and The Best Award in the Invention & Innovation Awards 2014 held at the Malaysia Technology Expo (MTE) 2014, which was hosted in Kuala Lumpur, Malaysia, on 20-22 Feb 2014. He is a Member of EU Academy of Sciences (EUAS) since July 2017. He got A Slottow Owaki Prize of SID in 2018. He is 2019 Distinguished Fellow of IETI (International Engineering and Technology Institute). Since 2018 he works as Professor in the School of Physics and Optoelectronics Engineering in Foshan University, Foshan, China. 2020-2024 Vice President of Fellow of Institute of Data Science and Artificial Intelligence (IDSAI) Since 2021 distinguished Fellow of Institute of Data Science and Artificial Intelligence.



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The enhanced cytotoxic effect of curcumin on leukemic stem cells via CD123-targeted nanoparticles

Treating Acute Myeloid Leukemia (AML) remains challenging due to its resistance to drugs and high rates of relapse. One major mechanism of AML relapse is involved in the remaining Leukemic Stem Cells (LSCs) in bone marrow. The prolonged residence of LSCs in the quiescent (G0) stage and the highly expressed P-glycoprotein drug transporter have been shown to allow them to evade chemotherapeutic drugs. LSCs are considered to be the root of chemotherapeutic drug resistance and relapse in AML patients. Hence, targeting LSCs emerges as a promising therapeutic target. CD123 is overexpressed in LSCs and leukemic blasts, but not in normal stem cells. CD123 thus represents a promising target molecule for drug delivery in order to specifically eradicate LSCs. In this study, we aimed to target and eliminate LSCs using CD123 as a key marker and curcumin as therapeutic agent. Curcumin, the active compound found in turmeric (Curcuma longa Linn.), is known for its ability to inhibit leukemic cell growth and is generally safe for humans in doses up to 8000 mg/day over three months. Unfortunately, its efficacy is limited by poor bioavailability, low water solubility, and rapid clearance from the body. To improve these limitations and enhance the selective eradication of LSCs, curcumin was encapsulated into nanoparticles to form nanocurcumin and then conjugated nanocurcumin with an anti-CD123 antibody (anti-CD123-Cur-NPs). The cytotoxicity of anti-CD123 Cur-NPs and curcumin-loaded nanoparticles (Cur-NPs) against KG-1a cells, serving as a model of leukemic stem cells, was investigated through the MTT assay. Our finding revealed that Cur-NPs and Cur-NPs-CD123 exhibited cytotoxic effects on KG-1a cells with the IC50 values of 74.20 ± 6.71 and 41.45 ± 5.49 μM, respectively. However, both Cur-NPs and anti-CD123-Cur-NPs did not show a cytotoxic effect on normal Peripheral Blood Mononuclear Cells (PBMCs). Moreover, anti-CD123-Cur-NPs treated KG-1a cells significantly enhanced the apoptotic cell number, when compared to Cur-NPs treated KG-1a cells. The higher uptake of anti-CD123-Cur-NPs in KG-1a cells was confirmed by using flow cytometry. In conclusion, the anti-CD123-Cur-NPs improved curcumin's bioavailability and specific targeting of LSCs, suggesting that it is a promising drug delivery system for improving the therapeutic efficacy against AML.

Audience Take Away Notes

- The audience can use insights from the study to explore new treatment strategies for AML, particularly those focusing on targeting LSCs through specific markers like CD123
- The methods for encapsulating and targeting drugs with nanoparticles can be applied to other therapeutic agents and diseases, optimizing drug delivery and efficacy
- The research highlights that the nanoparticle formulations showed no cytotoxic effects on PBMCs, which is crucial for developing safer cancer treatments

- By specifically targeting LSCs, the proposed treatment could improve the accuracy of AML therapies, potentially leading to better patient outcomes and reduced relapse rates

Biography

Wariya nirachonkul is a Ph.D. candidate in Biomedical Science at Chiang Mai University, Thailand. She earned a B.S. in Medical Technology with first-class honors from Chiang Mai University in 2017. From 2021 to 2023, she served as a visiting scholar at the Department of Pharmaceutical Chemistry, School of Pharmacy, University of Kansas, gaining valuable international research experience. Their work has been supported by the Royal Golden Jubilee Scholarship from the Thailand Research Fund.

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Effect of curvature on the dynamic behavior of carbon nanotube reinforced FGM shells

In the present paper an analytical model was developed to study the non-linear vibrations of Functionally Graded Carbon Nanotube (FG-CNT) reinforced doubly-curved shallow shells using the Multiple Scales Method (MSM). The nonlinear partial differential equations of motion are based on the FGM shallow shell hypothesis, the non-linear geometric Von-Karman relationships, and the Galerkin method to reduce the partial differential equations associated with simply supported boundary conditions. The novelty of the present model is the simultaneous prediction of the natural frequencies and their mode shapes versus different curvatures (cylindrical, spherical, conical, and plate) and the different types of FG-CNTs. The results obtained showed that the curvature and the number of modes have considerable effects on the variation of the effective nonlinearity αe as well as the displacement a. The frequency response of the shallow shells of the FG-CRNTC showed two types of nonlinear behaviors (hardening and softening) which are strongly influenced by the change of the curvatures of the shallow shells.

Audience Take Away Notes

- The analytical model used allows vibration analysis
- Modulation equations have been developed and solved to represent the frequency-response curves as a function of the number of modes retained in our approximation
- The behavior of the shell in the vicinity of the resonance was valued by the effective nonlinearity and the displacement
- Our study is based on the effects of the curvature on the natural frequencies of the shell with low curvatures reinforced by CNTs
- It has been shown that the non-dimensional frequencies depend on the number of modes retained and the shell curvature, the variation of the latter leads to a significant change in the stiffness of the shell

Biography

Dr. HAMMOU studied Chemistry at the Oran University, Algeria and graduated as DES in 2000. She then joined the research group of Prof. SEREIR at the Composite Structures and Innovative Materials Laboratory, Mechanical Engineering Faculty, University of Science and Technology of Oran. She received her PhD degree in 2022 at the same institution. She has published 3 research articles.

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POSTER PRESENTATIONS

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Increasing the fatigue strength of aluminum alloy parts using composite coatings for aerospace engineering

Aluminium alloys are widely used in aerospace engineering. Unfortunately, fatigue properties of aluminium alloys are not sufficient and their increase is very important scientific and practical task The article is devoted to the studies of the Al_2O_3 composite coatings' effect on bending fatigue tests of aluminium specimens. Initially, the coatings were formed by converting the surface of aluminum alloy specimens by Anodic-Cathodic Microarc Treatment (ACMAT) to a depth of 90-110 microns. Then the resulting coating was cladded with a "Cr-CrC" surface layer of 9-14 microns' thickness by pyrolysis from the vapor phase of a chromium-organic liquid. The clad layer filled the pores and cracks of the Al_2O_3 coating that formed after the ACMAT. Based on the analysis of bending fatigue tests results, it is shown that the formed composite layer can be used as a reinforcing coating in aerospace engineering. The effectiveness of the developed coating depends on the part's section thickness and the level of its loading. In the case under consideration, with cyclic bending stresses of less than 95 MPa, the increase in fatigue strength was 1.75-1.8 times.

Keywords: Ceramics, Composite Coatings, Space, Resource, Fatigue Strength.

Biography

Dr. Kalinichenko studied Foundry at the Belarusian National Technical University (BNTU), Belarus and graduated as Engineer in 1972. He then joined the research division at the BNTU. He received his PhD degree in 1978 and D.Sc. degree in 2001 at the same university. Since 2019 he is Director of the Center and Professor of Material Science Department at the Belarusian State Technological University. He has published more than 350 research books and articles in SCI(E) journals and publishing houses, co-author of more than 40 patents.

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DFT calculation of ZNO iron doped optical and optoelectronic properties using quantum espresso

Incorporation of Fe ions into the ZnO host matrix, leading to the adjustment of optical band gap and photoluminescence properties. To substantiate our experimental findings, we conducted computational analyses using Quantum espresso, first-principle calculations based on density functional theory. The examination focused on the effects of substitutional doping of Fe on the Zn site within a 3×3×1 supercell of the wurtzite ZnO crystal structure, considering different concentration levels (4%) and its impact on structural and electronic properties. Formation energy calculations revealed that the ZnO crystal structure is thermally stable, with enhanced stability achieved through Fe doping. The lattice constant of Fe-doped ZnO crystal structures exhibited a slight decrease, resulting in an increased electronic band gap, consistent with our experimental observations. Furthermore, our analysis demonstrated that Fe doping at the cation site in the wurtzite ZnO crystal structure effectively tunes the band gap to a larger value. Fe doping was identified as a significant contributor to the improvement of electronic properties. Finally, antibacterial tests revealed enhanced antibacterial activity of Fedoped ZnO nanoparticles, suggesting a correlation with the improved structural, optical, and photoluminescence properties observed in our study.

Biography

Hassan Idriss Abaker Idriss earned his Ph.D in Physics from the Department of Physics, Faculty of Science, Sudan University of Science and Technology (Sustech), in 2017 on Synthesis and characterizations of carbon nanotubes CNT using CVD and SEM. Also his MSc was in Applied physics, University Malaya, Kuala Lumpur Malaysia 2009, he has been conducted his MSc project on nanomaterial morphological studies of Anodic Aluminum Oxide (AAO) membrane using fractal methods. During his studies, He has exposed to handle a few instruments such as CVD, SEM, MBE, and some software programs. Besides that, He already collect & learned about several articles related to nanomaterials and other Nanotech's in general. He worked as TA, Lecturer at International University of Africa IUA since graduate and lastly at Sudan International University SIU; both in Khartoum-Sudan. Besides that was director and researcher at Africa City of Technology, Center of Nanotechnology in Khartoum Bahri, Sudan. Hope so, his knowledge on instruments and experiences that he has gained in the science are transferable for pursuing & working environment with researchers from different backgrounds at the conference with gaining more knowledge's and experience under you're pleasant welcoming.

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Comparative study of the domain wall pinning in cobalt micropowders and nanowires by the two nuclear magnetic resonance methods

Two alternative NMR methods under the influence of an additional magnetic video-pulse for the measuring of the pinning (fixation) force of domain walls in one-dimensional nanostructures, such as cobalt nanowires, were proposed and investigated. All necessary detailed information on the original method for the synthesis of cobalt micropowders and nanowires is provided. The characteristics of pinning centers of domain walls in cobalt micropowders and nanowires are studied by two alternative methods of nuclear magnetic resonance observed as an echo signal under the influence of an additional magnetic video-pulse: by the effect of a magnetic video-pulse on a two-pulse echo signal and by the threshold for generating a magnetic echo signal at combined influence of a radiofrequency pulse and a magnetic video-pulse on a sample. It is shown that the degree of pinning of domain walls in cobalt linearly depends on the external constant magnetic field. Potential applications include the creation of sensor devices and permanent magnets that do not contain rare earth elements. This work was supported by Shota Rustaveli National Science Foundation of Georgia (SRNSFG) grant # [FR-22-7899].

Audience Take Away Notes

- Magnetic nanomaterials with controllable morphology and dimensions are important for the fabrication of nanoscale devices and functional materials. Recently, the formation of One-Dimensional (1-D) nanostructures, such as nanowires, has attracted considerable attention due to their large anisotropic surface magnetism, which is excellent for applications in permanent magnets, high-density magnetic storage media, sensors, and catalysts. 1-D Co nanostructures have been prepared by a variety of methods, among them by template-based electrodeposition successfully fabricating well aligned magnetic nanowires with controllable diameter and length
- However, application of this method to large-scale production is complicated by the preparation of the templates and their subsequent removal from the nanowires. Recently, the application of magnetic fields during solution reduction for hydrothermal and solvothermal synthesis, has been widely used to fabricate 1-D Co nanostructures due to its simplicity and effectiveness. However, these processes need high temperature, high pressure, and long reaction time
- In this work simple and effective low-temperature electroless method providing synthesis of cobalt micro- and nanowires due to self-organization processes of cobalt magnetic nanoparticles under magnetic field influence, is elaborated allowing for a development of electroless technology for synthesis of magnetic nanoparticles and nanowires. It requires the interdisciplinary research with participation of physicists, chemists, materials scientists and technologists
- Currently many efforts have been focused on the RE free permanent magnets due to various issues arising from the RE elements, among them the need to lightened supply of Rear-Earth (RE) elements in the global market

- We propose to obtain magnets of this type with a polymer matrix by using the combined effect of temperature, variable and constant magnetic fields to orient nanowires in the polymer matrix, using Co nanowires obtained by electroless method

Biography

Dr., Professor Tsisana Gavasheli is Candidate of Physical-Mathematical Sciences, Ph.D. / Academic doctor (1995). Chief Specialist at TSU Department of Scientific Research and Development (since 2011). Associated Professor of Faculty of Exact and Natural Sciences (since 2012). More than 30 years of teaching experience at the Faculty of Exact and Natural Sciences of TSU. 20 years' experience in research project management/execution (international and national). 12 years' experience in research administration, research data processing and analysis. Author of more than 70 publications. IEEE Member (since 2014). Member of International EPR Society (since 2002). Member of AUTM (Association of University Technology Managers, since 2014).

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Selenium biotransformation into Nano-Se by probiotics

This study investigated the participation of probiotic microorganisms in the synthesis of selenium nanoparticles (Nano-Se) and compared certain aspects of different mechanisms of Nano-Se synthesis by *L. plantarum* and *B. subtilis*.

To obtain the biogenic Nano-Se with the help of probiotic microorganisms, the nutrient medium was enriched with sodium selenite in different concentrations from 1 to 30 ppm for Se and cultivated in aerobic conditions using a shaker and compared with the corresponding samples that were cultivated in static conditions. The growth of bacteria was evaluated by Viable cell count, the formation of Nano-Se was evidenced by the change and intensity of red color, then confirmed by Transmission (TEM) Microscopy. The green synthesized Nano-Se from probiotic microorganisms were characterized by UV-visible spectroscopy. It was found that the number of viable *L. plantarum* IMB B-7679 during cultivation in the presence of 30 ppm Se in the composition of Na_2SeO_3 decreased by 1.5 times compared to the control and the appearance pink colors of the cultural environment were observed. According to TEM data, the intracellular pathway of Nano-Se formation by *L. plantarum* was proven. Visualized by TEM, Nano-Se synthesized by *L. plantarum* IMB B-7679 had a spherical shape and their size ranged from 150-180 nm. The same time *B. Subtilis* IMB B-7392 and IMB B-7393 displayed the tolerance against Na_2SeO_3 is due to the extracellular formations of Nano-Se, which were confirmed by TEM. Analysis TEM revealed the presence of electron-dense Nano-Se particles, and the formation of nanoagglomerates, which were localized extracellularly and had the average size of 120±20 nm for *B. subtilis* IMB B-7392 and 370±92.4 nm (±SD) for IMB B-7393. It should be noted that the extracellular biosynthesis of Nano-Se is preferable to the intracellular synthesis of Nano-Se, as it occurs outside the bacterial cell and it is cheaper to obtain Nano-Se.

The formation of Nano-Se was confirmed by UV-Vis absorption spectra, which showed absorption bands for Nano-Se produced by L. plantarum IMB B-7679 at 240 nm and Nano-Se formed by *B. subtilis* IMB B-7392, B-7393, respectively λ 230 and 251 nm. So, bacterial reduction of Na_2SeO_3 to Nano-Se is a promising method for obtaining selenium-enriched probiotics.

The capacity for intracellular Nano-Se production requires the maintenance of intracellular redox homeostasis to protect cells from oxidative damage. There is an assumption that glutathione is involved in the reduction of selenite in certain strains of lactobacillus.

Meanwhile, *Bacillus subtilis* is a probiotic bacterium that has a different aerobic extracellular mechanism to reduce Se (IV) to Nano-Se. It is known that, cultures of *B. Subtilis* do not have the enzyme glutathione but they do have bacillithiol. In addition, the reduction of selenite to biogenic Nano-Se by *B. Subtilis* occurs with the participation of thioredoxin reductase and reduced thiols, which are contained in microbial cells and can catalyze the reduction of selenite.

But the increase in the intensity of the red color of the medium culture of *B. Subtilis* IMB B-7393 under aerobic conditions, makes it possible to predict the involvement of additional enzymes to explain the biological reduction of SeO_3^{2-}.

So, aeration is an essential parameter for the growth of *Bacillus subtilis* and *L. plantarum* cultures, selenium is involved in biotransformation processes under aerobic conditions, but the localization of Nano-Se are different, which may be related to different ways of its biotransformation. The inexpensive and ecological method of obtaining Nano-Se with the help of probiotics can be an alternative to chemical and physical methods of obtaining nanoforms.

Biography

Tymoshok Natalia Olexandrivna has been working at D.K. Zabolotny Institute of Microbiology and Virology NASU, Ukraine. She received her PhD degree in 2002 at the same institution. She specializes in nanotechnology, with a focus on green synthesis and the application of nanoparticles. Her research aims to determinate of the physiological role of the interferon system and its inducers in physiological norms and pathological processes as well as provide determination of immunomodulatory, antibacterial, anti-inflammatory properties of probiotic. Determination of biological activity of selenium and cerium nanoparticles in model systems. Development of biotechnology for the production of nanoselenium using probiotic bacteria.

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