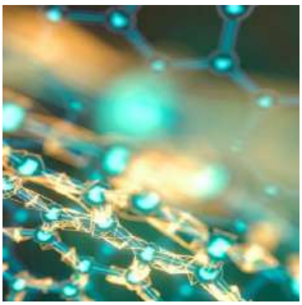
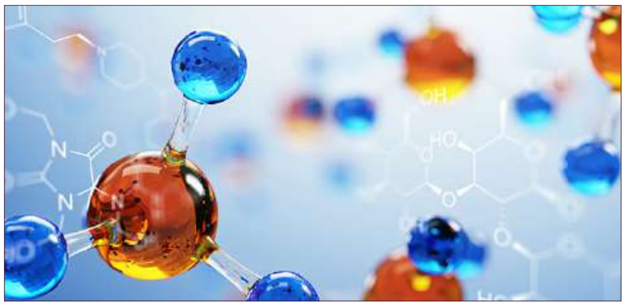
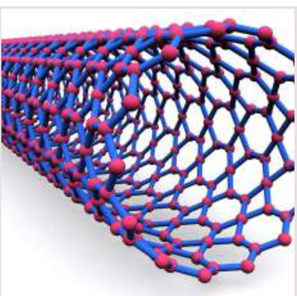
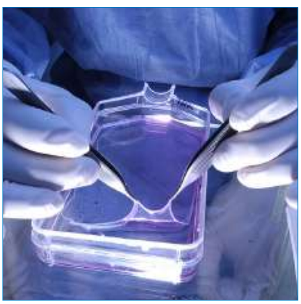
Poster

Biomaterials 2022









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Elaboration and Characterization of MnO_2-Nanosheets Nanomaterial: Application for Removal of Pb(II) and Cd(II)

Amina Amarray[1], S El ghachtoulia[1], M Dahbib[2] and **M Azzia[1]**
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Heavy metals are discharged into water from various industries. They can be toxic or carcinogenic in nature and can cause severe problems for humans and aquatic ecosystems. Thus, the removal of heavy metals from wastewater is a serious problem.

Various treatment technologies employed for the removal of heavy metals include chemical precipitation, ion exchange, chemical oxidation, reduction, reverse osmosis, ultrafiltration and electrodialysis. The adsorption method has proven the most effective because of its simplicity, ease of operation, and high efficiency over a wide range of concentrations. Typical adsorbents for heavy metals include perlite, hydroxyapatites, peat, carbon nanotubes, activated carbon, alumina and clay. However, these adsorbents have several disadvantages, such as low adsorption capacity, low selectivity, and a long time equilibrium. In this study, we investigated the adsorption behavior of Pb(II) and Cd(II) by MnO_2 nanosheets (MnO_2-NS) in an aqueous medium. The synthesis of (MnO_2-NS) is based on the exfoliation of an intermediate material lamellar leading to the formation of the nanosheets-MnO2 material with negative charges on its outer surface, which causes a strong attraction of positively charged pollutants like metal cations. The nanomaterial has been characterized by different spectroscopic techniques (XRD, SEM….etc). The study of interaction in an aqueous medium between the MnO_2 nanosheets and the metal cations Pb(II) and Cd(II) showed that the materials are highly reactive towards the metal cations.

Speaker Biography

Amina Amarray is a Ph.D. student in chemistry and valorization at Hassan II University since 2017 at the Materials Environment Interface Laboratory, under the direction of Mrs. S. ELGHACHTOULI and Mr. M. AZZI. She is working on the development and characterization of nanomaterials by chemical and electrochemical routes for the removal of organic and inorganic impurities from water.

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Modulation of Conductivity of Alginate Hydrogels Containing Reduced Graphene Oxide through the Addition of Proteins

Ahmed Raslan
Universidad Del País Vasco, Spain

Modifying hydrogels in order to enhance their conductivity is an exciting field with applications in cardio and neuro-regenerative medicine. Therefore, we have designed hybrid alginate hydrogels containing uncoated and protein-coated reduced graphene oxide (rGO). We specifically studied the adsorption of three different proteins, BSA, elastin, and collagen, and the outcomes when these protein-coated rGO nanocomposites are embedded within the hydrogels. Our results demonstrate that BSA, elastin, and collagen are adsorbed onto the rGO surface, through a non-spontaneous phenomenon that fits Langmuir and pseudo-second-order adsorption models. Protein-coated rGOs are able to preclude further adsorption of erythropoietin, but not insulin. Collagen showed better adsorption capacity than BSA and elastin due to its hydrophobic nature, although requiring more energy. Moreover, collagen-coated rGO hybrid alginate hydrogels showed an enhancement in conductivity, showing that it could be a promising conductive scaffold for regenerative medicine

Speaker Biography

Ahmed Raslan is an Assay Development Scientist. He Pursued his PhD. in Universidad Del País Vasco, Spain.

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Synthesis And Characterization of Naturally Derived Sio_2 and Cao for 45S5 Bioactive Glass as An Application in Wound Healing

Samadhan B Gaikwad
Shivaji University, India

The management of skin damage is assumed an unmet clinical need, and no entirely satisfactory solution to this problem exists to date. Bioactive glass (BG) has long been studied in mineralized tissue regeneration, but its potential applications in soft tissue repair, particularly wound healing, have recently shown great promise. Ordinary bio glass like the silicate-based BG 45S5 has been implicated in the stages of wound healing. Herein we prepare the naturally derived biomaterials by using beach sand as a source of high purity silica and eggshell biowaste as a source of calcium to prepare 45S5 BG using the sol-gel method. X-ray diffraction, field emission scanning electron microscopy, Fourier transform infrared spectroscopy, and Raman spectroscopy was used to determine crystal structure, particle morphology, and the presence of chemical functional groups in the synthesized materials. The biomimetic mineralization of the scaffolds is carried out using stimulated body fluid that mimics the inorganic composition of human blood plasma, and the hydroxyapatite nucleation on the scaffold is confirmed. The highly vascularized chicken chorioallantois membrane (CAM), which surrounds the embryo, can be used to visually examine the angiogenic effect of therapeutics applied to the ex-ovo chicken embryo. These findings indicated that bioactive glass derived from natural sources could improve biological properties for wound healing applications.

Speaker Biography

Samadhan B. Gaikwad pursuing a Ph.D. degree in the Department of Chemistry at Shivaji University, India.

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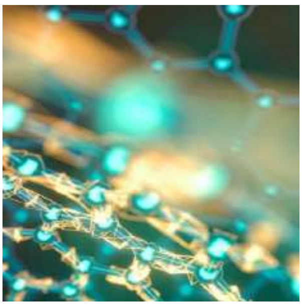

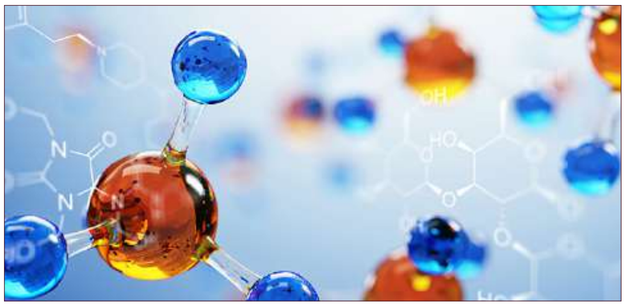

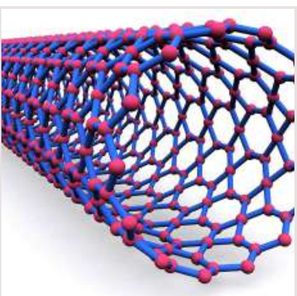

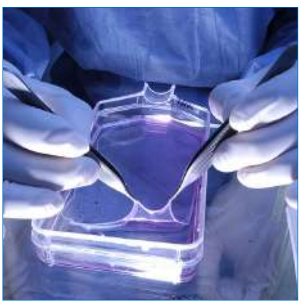

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A Machine Learning Approach to Analyze the Surface Properties of Biological Materials

Carolin A Rickert
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Similar to how CRISPR has revolutionized the field of molecular biology, machine learning may drastically boost research in the area of materials science. Machine learning is a fast-evolving method that allows for analyzing big data and unveiling correlations that otherwise would remain undiscovered. It may hold invaluable potential to engineer novel functional materials with desired properties – a field, which is currently limited by time-consuming trial and error approaches and our limited understanding of how different material properties depend on each other. Here, we apply machine learning algorithms to classify complex biological materials based on their micro-topography. With this approach, the surfaces of different variants of biofilms and plant leaves can not only be distinguished but also correctly classified according to their wettability. Furthermore, an importance ranking provided by one of the algorithms allows us to identify those surface features that are critical for a successful sample classification. Our study exemplifies how machine learning can contribute to the analysis and categorization of complex surfaces – a tool, which can be highly useful for other areas of materials science, such as damage assessment as well as adhesion or friction studies.

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Cartilage Defect Treatment Using High-Density Autologous Chondrocyte Implantation

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Autologous chondrocyte implantation (ACI) is a worldwide recognized therapy to treat focal cartilage lesions. Since the first publication in 1994, it has evolved from the use of cell cultures as a cell suspension injected under a periosteal flap covering the defect, to the use of biomaterials such the type I/III porcine collagen membrane used in MACI. Here we describe the experiments followed by our group to develop a modification of MACI called High Density- Autologous Chondrocyte Implantation (HD-ACI) in which cell density is increased 5-fold. In classical ACI, 5 million of cultured chondrocytes were implanted in the cartilage defect, but the use of periosteum increased morbidity. In MACI, 20 million cells are seeded in a 20 cm2 collagen membrane, so cartilage defects are treated with a density of 1 million cells per cm2. In this case, surgeons observed that neo-formed tissue was soft and had scarce cell number. We proposed to increase cell density to 5 million cells per cm2, and first of all we had to prove its safety and effectiveness in a sheep model. In these experiments, 1 million and 5 million chondrocytes as well as 5 million mesenchymal stem cells were tested in 1 cm2 defects performed in the cartilage of the medial femoral condyle. In all animals, we carried-out other cartilage defects that were repaired with micro fractures. Histological and molecular studies demonstrated that the animals treated with 5 million chondrocytes regenerated cartilage defects with a better hyaline cartilage than those treated with 1 million cells while fibrocartilage was produced in the animals treated with mesenchymal stem cells and in the defects treated with micro fractures. Currently, 336 patients (251 in the knee, 82 in the ankle and 3 in the hip) have been treated with HD-ACI and in this work, we present the results of 176 treated in the knee, 48 in the ankle and 8 patients with bilateral knee cartilage defects, being both knees treated in a surgical act, under the same anesthesia. Our results demonstrate that HD-ACI is a safe and effective technique for the treatment of cartilage defects, giving rise a neo-formed hyaline tissue and improving clinical and subjective perception of the joint functionality.

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Air Polishing Damaging Particles and PPE Effectiveness against them

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Particles such as bicarbonate, silicon dioxide or glycine, are frequently used in air polishing practice in dentistry. In different forms, their prolonged-use leads to serious consequences in pulmonary and airways, eye and integumentary systems. The aim of this study is to analyze the ability of these particles to spread out through the workspace, and the effectiveness of PPE (personal protection equipment) in protecting the operator against these molecules. Paper patches (25x25mm in size, each square divided into 5x5mm grid, in association with fluorescein) were applied behind PPE of a volunteer, and others placed at different distances from the operating site. Twenty repetitive patches were removed from their position and UV rays treatment revealed the contaminated squares: every patch presented non-negligible tracks, revealing PPE may not be entirely safe to protect the operator against harmful particles. Moreover, the same PPE penetrating particles could spread out and settling through the workspace.

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The Interplay between Hemostasis and Immune Response in Biomaterial Development for Osteogenesis

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Treatment of large bone defects, especially bone non-union remains a clinical challenge. The gold standard bone substitute is still the autologous bone graft and is difficult to be replaced by synthetic biomaterials, suggesting that strategies should be made to improve the material for functional bone regeneration. Recent studies have revealed that hematoma, the first tissue structure formed at the bone injury site, plays an indispensable role in bone healing. Hematoma consists of fibrin clot, infiltrated immune cells, and tissue progenitor cells, which not only bridge the bone defect, but also provide a microenvironment for the interplay between hemostasis and immune systems. Previous studies have found that an ideal fibrin structure with proper fiber thickness and density could benefit progenitor cell infiltration and differentiation, and biomaterial implantation could affect bone healing by altering fibrin structure. Meanwhile, immunoregulation plays an indispensable role in bone healing, especially, materials inducing a shift from inflammatory to anti-inflammatory phenotypes in immune cells showed enhanced osteoinductivity. The balance between coagulation—inflammation and anti-coagulation—anti-inflammation plays a determinant role in not only fibrin structure but also the fibrinolysis process, during which the inflammation could be gradually "quenched" and thereby generating an ideal microenvironment for the following bone regeneration. Therefore, it is essential to develop biomaterial targeting the hemostasis-immune interplay.

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