Surface Engineering of Biomaterials, Medical Devices and Regenerative Materials
Room Palm 1-2 - Session MD1-1-MoM

Development and Characterization of Bioactive Surfaces/Coatings I

Moderators: Dr. Mathew T. Mathew, University of Illinois College of Medicine at Rockford and Rush University Medical Center, USA, **Dr. Sandra E. Rodil**, Universidad Nacional Autónoma de México

10:00am **MD1-1-MoM-1 Hybrid Ceramic Coating with Enhanced Corrosion Resistance for Magnesium-Based Biodegradable Implants***, **Abdelrahman Amin [xml111@mocs.utc.edu]**, Diya Patel,* University of Tennessee at Chattanooga, USA*; Bryce Williams, Thomas McGehee, Alyssandra Navarro, Mostafa Elsaadany,* University of Arkansas, USA*; Hamdy Ibrahim,* University of Tennessee at Chattanooga, USA*; Merna Abdrabo,* The University of Tennessee at Chatanooga, USA

Biodegradable implants, recognized for their unique mechanical properties and compatibility with human bone, have become essential in various biomedical applications. Magnesium, a key material in such implants, is notable for its favorable biodegradability within the human body. However, one limitation of magnesium is its tendency to degrade too quickly, leading to a loss of mechanical integrity before bone healing is complete. This rapid degradation can undermine the implant's effectiveness, driving efforts to manage magnesium's high corrosion rate through various approaches. Among these, the development of protective coatings on magnesium alloys has shown significant promise. Such coatings provide a temporary protective layer, thereby slowing down the corrosion process and extending the implant's functionality. Hybrid coatings, particularly those combining Plasma Electrolytic Oxidation (PEO) with sol-gel techniques, have improved the ability to control and adjust corrosion rates while incorporating bioactive agents like hydroxyapatite (HA) nanoparticles. These nanoparticles contribute to enhanced bioactivity and osteoconductivity, further supporting bone healing. In this study, the primary objective is to explore how altering the key parameters of Sol-gel coating affects the corrosion resistance of a magnesium alloy substrate that has been pre-coated with a PEO layer. Specifically, the combined impact of varying HA concentration within the Sol-gel solution, dip time, and the number of layers deposited are examined. The findings of this work establish the relationship between the sol-gel coating process parameters and the corrosion properties of the developed hybrid coating leading to a better understanding of their effect on developing magnesium-based implants with superior properties.

10:20am **MD1-1-MoM-2 Functional Coatings by Low Vacuum Plasma for the Innovation in Regenerative and Reparative Medicine***, Pascale Chevallier, Carlo Paternoster, Francesco Copes,* Laval University, Canada*; Andranik Sarkissian,* Plasmionique Inc., Canada*; **Diego Mantovani [diego.mantovani@gmn.ulaval.ca]**,* Laval University, Canada **INVITED**

Over the last 50 years, biomaterials, prostheses and implants saved and prolonged the life of millions of humans around the globe. Today, nano-biotechnology, nanomaterials and surface modifications provide a new insight to the current problem of biomaterial complications, and even allows us to envisage strategies for the organ shortage. In this talk, creative strategies for modifying and engineering the surface and the interface of biomaterials, including metals, polymers from natural and synthetic sources, will be discussed. The unique potential of low-pressure low-temperature plasma surface modification will be detailed with the overall aim to envisage today how far innovation can bring tomorrow solutions for reparative and regenerative medicine. Applications for health will be emphasized, including biologically active-based, biomimetic, low-fouling, bactericidal, and antiviral coatings.

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11:00am **MD1-1-MoM-4 10-h2da Coating on Polyvinyl Chloride Catheter Biomaterials for Prevention of Candida-Associated Urinary Tract Infections***, **Jermiah Tate [jdtate3@memphis.edu]**, Joel Bumgardner, Tomoko Fujiwara, J. Amber Jennings,* University of Memphis, USA

Urinary catheters made of polyvinyl chloride (PVC) are susceptible to microbial biofilm formation. 10-hydroxy-2-decenoic acid (10-H2DA) is a dispersal signaling molecule known to inhibit biofilm and planktonic growth of microorganisms. This study hypothesized that coating PVC with 10-H2DA would inhibit planktonic and biofilm-associated Candida albicans. Interactions of the PVC and 10-H2DA molecules were analyzed using Video Contact Angle (VCA), Fourier Transform Infrared (FTIR), and High-Performance Liquid Chromatography (HPLC).Successful coating of PVC with 10-H2DA was demonstrated through a lowered contact angle. The control group displayed an average contact angle of 107° with a p value <0.0001 of significance compared to the following groups:10mg/ml (65.8°), 15mg/ml (80.7°), and 20 mg/ml (55.8°). FTIR peaks appeared in regions indicative of the 10-H2DA on the surface of PVC. Elution data displays a burst release of 50% 10-H2DA within 3-6-hours. After 48 hours of incubation, over 60% of planktonic C. albicans growth was inhibited (p<0.0001) in the environment of PVC coated with 10-H2DA compared to uncoated PVC. There were no significant reductions of biofilm. Immersing PVC in 10-H2DA showed short-term surface activity, attributed to the short timeframe of release of 10-H2DA. Further investigations will explore anti-biofilm properties of 10-H2DA on the PVC surface against other common microorganisms responsible for biofilm development on urinary catheters and chemical conjugation for longer term release.

11:20am **MD1-1-MoM-5 Hydrogen-Treated Orthopedic Implants : A Novel Approach to Enhance Biocompatibility and Mitigate Inflammation***, **Ren-Jei Chung [rjchung@mail.ntut.edu.tw]**,* National Taipei University of Technology, Taiwan **INVITED**

The surface modification of cobalt-chromium-molybdenum (CoCrMo) alloy to create hydrogenated CoCrMo (H-CoCrMo) surfaces has shown promise as an anti-inflammatory orthopedic implant. Utilizing the electrochemical cathodic hydrogen-charging method, the CoCrMo alloy surface was hydrogenated, resulting in improved biocompatibility, reduced free radicals, and an anti-inflammatory response. *In vitro* studies demonstrated enhanced hydrophilicity and the deposition of hydroxyapatite. The cell study result revealed a suppression of osteosarcoma cell activity. Finally, the *in vivo* test suggested a promotion of new bone formation and a reduced inflammatory response. The diffusion of hydrogen to a depth of approximately 106 ± 27 nm on the surface facilitated these effects. The findings suggest that electrochemical hydrogen charging can effectively modify CoCrMo surfaces, offering a potential solution for improving orthopedic implant outcomes through anti-inflammatory mechanisms.

Surface Engineering of Biomaterials, Medical Devices and Regenerative Materials
Room Palm 1-2 - Session MD1-2-MoA

Development and Characterization of Bioactive Surfaces/Coatings II

Moderators: Dr. Hamdy Ibrahim, University of Tennessee at Chattanooga, USA, **Dr. Sandra E. Rodil**, Universidad Nacional Autónoma de México

1:40pm **MD1-2-MoA-1 Surface Characteristics of Magnesium-Based Nanocomposite for Enhanced Biomedical Implants***, **Merna Abdrabo [jgs684@mocs.utc.edu]**, Tooba Tanveer, Abdelrahman Amin, Diya Patel,* University of Tennessee at Chattanooga, USA*; Thomas McGehee, Mostafa Elsaadany,* University of Arkansas, USA*; Hamdy Ibrahim,* University of Tennessee at Chattanooga, USA

Magnesium (Mg) possesses unique properties that make it a promising candidate for various biomedical applications. That includes biodegradability and an elastic modulus that is closer to that of the human bone compared to titanium and stainless-steel implants, significantly reducing the risk of stress shielding. However, the use of magnesium in biomedical implants has been limited by its high chemical reactivity and limited strength. Therefore, a significant amount of research has been focused on enhancing the strength and corrosion characteristics of Mg-based biomedical implants by developing nanocomposites through novel fabrication methods. This study focuses on investigating the surface properties of novel Mg-based nanocomposites containing boron nitride and silicon carbide nanoparticles. The examination includes testing the morphology, corrosion characteristics, microhardness, wettability, and in-vitro cytotoxicity of the prepared surfaces. In this work, a novel acoustic powder mixing technique, combined with powder metallurgy, is utilized to prepare the Mg-based nanocomposite samples. The findings of this work provide a good understanding of the effect of the process parameters on the corrosion characteristics of these novel materials, which could pave the way for the manufacturing of Mg-based implants with superior properties, contributing to advanced applications in the biomedical field.

2:00pm **MD1-2-MoA-2 Carbide Derived Carbon Conversion Coatings for Tribological Applications***, **Mike McNallan [mcnallan@uic.edu]**,* University of Illinois - Chicago, USA **INVITED**

Carbide Derived Carbon (CDC) is a unique structure of carbon that is produced by extraction of the metal component from a ceramic carbide. When the conversion is carried out at a temperature below 1200 degrees Celsius, the result is a disordered graphitic structure with largely sp2 bonding. This is because there is not sufficient thermal energy under these conditions for the carbon to relax fully from the ceramic structure to the equilibrium graphitic state.

Carbide Derived Carbon (CDC) has a slick, hydrophobic surface and a low coefficient of friction when paired with most other materials. Because it is grown into a ceramic surface, rather than deposited onto the surface by a CVD or PVD process, CDC coatings can be applied with minimal dimensional changes and are resistant to spallation in comparison to other tribological coatings. CDC coatings have been applied to SiC and WC ceramics by exposure to chlorine gas at temperatures in the range of 800 to 1000 degrees Celsius. In this temperature range, the metal species form volatile chlorides, while the carbon is left behind as a solid.

Tribocorrosion, in which synergistic degradation by corrosion and wear is a particular concern for orthopedic implants such as artificial joints. The Ti-6Al-4V alloy is popular for this application, and carbide ceramics are not favored for this application because of their inherent brittleness. Titanium is a strong carbide former, so titanium carbide surface layers can be formed on titanium alloys by a carburization treatment in a packed bed of carbon. Subsequently, a layer of carbide derived carbon (CDC) can be formed on the surface of the titanium carbide layer by chlorination or by an anodic electrolysis treatment in molten chloride salt. The formation of CDC can be verified by Raman spectroscopy and the improvement of tribocorrosion resistance can be verified by tribocorrosion testing at the free corrosion potential. The results demonstrate a dramatic decrease in corrosion when a CDC layer is present during mechanical sliding.

2:40pm **MD1-2-MoA-4 Nano-Mechanical Characterization of Sol-Gel Nanocoatings in the Context of Antibacterial/Antiviral Advanced High-Traffic Surfaces***, **Ilaria Favuzzi [ilaria.favuzzi@uniroma3.it]**, Edoardo Rossi,* Università degli studi Roma Tre, Italy*; Angelo Meduri, Mario Tului,* RINA-CSM, Italy*; Marco Sebastiani,* Univeristà degli studi Roma Tre, Italy

The global pandemic caused by the SARS-CoV-2 virus has prompted a re-evaluation of surface hygiene practices, leading to an increased focus on the use of antimicrobial coatings.Sol-gel methodologies, known for their durability and cost-effectiveness, have emerged as a leading technology. MIRIA European project aims to advance sol-gel technologies, utilising nanoparticles such as silver or copper to enhance safety in a variety of public environments (e.g. hospitals, public transportation) and contribute to infectious disease management strategies.

In this work, antimicrobial thin films were deposited via dip coating on glass substrates starting from silicon-based hybrid organic-inorganic sol-gel formulations.The formulations differed in terms of the organosilicon additives and the presence of nanoparticles.A nanomechanical integrated protocol was applied to assess mechanical proprieties, adhesion and wear durability, by using three primary testing methodologies: nanoindentation, scratch, and wear testing. Nanoindentation was conducted using a KLA G200 Nanoindenter in CSM mode to extract the elastic modulus and hardness of the films, with appropriate models employed to correct for substrate influences. Subsequently, abrasive wear tests were conducted in accordance with the UNI-EN1071-6 standard, while scratch resistance was evaluated using the same nanoindenter, configured for nano-scratch testing with a rounded cone tip and lateral force measurement. Moreover, the antibacterial efficacy against Staphylococcus aureus and the antiviral efficacy against the MOI0.5 virus were evaluated.

Two data-based interpretation models were employed to extract intrinsic hardness and modulus of the films from nanoindentation data. An increase in stiffness was observed in the nanoparticle-filled formulations. This is associated with improved adhesion (scratch critical loads), as an increase in modulus results in the maximum contact shear stress occurring at higher depths, thereby causing later chipping during scratch. The wear performance of the coatings was evaluated through abrasive wear tests, which demonstrated that all coatings enhanced wear resistance compared to the uncoated glass substrate. The coatings containing copper oxide nanoparticles demonstrated the highest resistance and were the most effective in terms of antimicrobial performance, achieving a 3log (99.9%) reduction in microbial count after a 24-hour contact period.

Finally, a critical evaluation on the potential industrial scale-up of the proposed coating solutions is presented.

4:00pm **MD1-2-MoA-8 Noble Nanoparticles Arrays Coating for Electrochemical (EC) and Surface-Enhanced Raman Spectroscopy (SERS) Biosensors***, **Ting-Yu Liu [tyliu@mail.mcut.edu.tw]**,* Ming Chi University of Technology, Taiwan **INVITED**

We have demonstrate a facile and low-cost preparation process to fabricate the laser scribed graphene (LSG)-based electrochemistry (EC) and surface-enhanced Raman spectroscopy (SERS)substrate for bio and environmental detection. LSG substrate was fabricated via laser scribed and deposited the Au nanoparticles on the LSG by thermal evaporation or electrochemical deposition. 3D porous microstructure of LSG can improve the SERS signal of Au@LSG substrate, and further fine-tune the thickness of Au nanoparticles (5-25 nm) to optimize the EC-SERS enhancement. The developed sensor demonstrates exceptional performance in detecting uremic toxins. The results show that 20 nm of Au nanoparticles coated on LSG substrate obtains the highest SERS enhancement effects, and successfully detects the dye molecules (rhodamine 6G, R6G) and uremic toxins (urea, uric acid and creatinine). The EC-SERS signals of R6G would enhance 17 times at the potential of -1.3 V, compared to SERS signals without applying an electric field. Moreover, the urea also displays 4 times higher at the potential of -0.2 V. Furthermore, it achieves remarkably low detection limits (10^{-3} M for creatinine/uric acid, 10^{-4} M for urea) and offers distinct, concentration-dependent responses for different toxins in cyclic voltammetry (CV) measurements. The detecting molecules could be selected to enhance SERS signals by different voltages, showing the capability of selectively detecting biomolecules, bacteria, and virus, which can solve the problem of complex sample pretreatment.

Surface Engineering of Biomaterials, Medical Devices and Regenerative Materials
Room Palm 1-2 - Session MD2-WeM

Surface Response to Biological Environments, Biointerphases, and Regenerative Biomaterials

Moderators: Po-Chun Chen, National Taipei University of Technology, Taiwan , **Dr. Jean Geringer**, Ecole Nationale Superieure des Mines, France, **Dr. Hamdy Ibrahim**, University of Tennessee at Chattanooga, USA

8:00am **MD2-WeM-1 Modulating Cell Responses via Surface Engineering***, Huinan Liu [huinanliu@engr.ucr.edu],* University of California, Riverside, USA **INVITED**

Engineered surfaces provide promising solutions to meet the clinical needs for medical implants and devices. Bioresorbable implants and devices are designed to degrade harmlessly in the body over time as new tissues grow, which eliminates the need for secondary surgeries and associated complications. Recent researches on biodegradable polymers and metals have demonstrated their potentials for clinical applications, but there are still major challenges yet to be addressed, e.g. (1) controlling their degradation rates and cellular responses to match tissue healing rates, and (2) modulating their bioactivities to promote healing functions of desirable cells while inhibiting bacterial infections. In this presentation, our recent progress on engineering bioresorbable alloys and surfaces to regulate the degradation rates and cell responses will be presented. The relationships between surface microstructure, degradation, and interactions with host cells and pathogenic microorganisms will be discussed.

8:40am **MD2-WeM-3 Nanomaterials and Thin Films: Revolutionizing Bio-Applications for Early Disease Detection***, Samir Iqbal [smiqbal@utrgv.edu],* University of Texas at Rio Grand Valley, USA **INVITED**

Modern nanofabrication techniques have enabled the creation of innovative architectures to interface with living systems, opening new frontiers in biotechnology and medical diagnostics. These development involves nanostructured or nanotextured sensor interfaces made from diverse materials, which exhibit remarkable antibacterial properties, enhanced cell adhesion, and, in some cases, unique interactions with normal and diseased cells. These surfaces hold significant promise for advancing biomedical applications.

Simultaneously, advancements in electronic miniaturization have led to the reproducible fabrication of nanoscale devices capable of interfacing with biological molecules. Leveraging microfluidics and nanoscale features, these devices can detect and identify molecular biomarkers and diseased cells with unprecedented precision. Such systems enable rapid, label-free, and selective chemical analyses from minute sample volumes, offering transformative potential for early diagnostics. Early detection of diseased cells, particularly when present in small numbers, is critical for improving survival rates in conditions such as cancer.

Nanomanufactured frameworks allow the combinatorial measurement of viscoelastic, mechanical, electrical, and chemical properties to transduce molecular and cellular anomalies into meaningful diagnostic signals. This talk will explore the role of nanoscale thin film properties in disease detection, emphasizing the importance of early cancer diagnosis. A comprehensive overview of molecular detection, isolation, and sorting of diseased cells using nanotechnology and microfluidics will also be provided, highlighting the transformative potential of these approaches in modern medicine.

9:20am **MD2-WeM-5 Green Fabrication of Conductive Carbon Thin Film Patterns for Biosensors***, Ying-Chih Liao [liaoy@ntu.edu.tw],* National Taiwan University, Taiwan **INVITED**

The demand for sustainable and cost-effective materials in biosensing is growing, especially for real-time and portable health monitoring. However, conventional electrode fabrication methods often require multiple processing steps and use non-renewable materials. This reliance raises environmental concerns and limits scalability. In this study, a green approach is developed to directly transform biodegradable bacterial cellulose (BC) into conductive carbon thin films using CO_2 laser-induced carbonization under ambient conditions for biosensor fabrication. Bacterial cellulose (BC) a biopolymer generated by specific bacteria, features a highly porous, nanoscale fibrous structure along with notable mechanical strength and biocompatibility. These properties make it a highly versatile material for biomedical applications. The laser-induced carbonization process leverages these unique structural features of BC, converting it into a conductive carbon matrix suitable for electrochemical applications. This one-step technique involves the precise application of a CO_2 laser, which locally heats the BC, breaking down organic components and rearranging carbon atoms to create conductive graphitic structures.

This approach integrates essential elements into the BC matrix, enhancing conductivity and sensor functionality without requiring complex post-treatments. The laser-induced carbonized BC electrode offers promising detection capabilities for glucose and lactate, enabling concurrent sensing in phosphate buffer solution (PBS) and demonstrating selectivity, reproducibility, and stability, verified through differential pulse voltammetry (DPV). This streamlined laser carbonization method facilitates electrode fabrication and yields electrodes capable of application in real sweat sample analysis.These characteristics highlight BC-based electrodes as highly promising candidates for portable, cost-effective on-site biosensors for monitoring key biomarkers in sweat, underscoring the potential of laser-induced carbonization in advancing sustainable, high-performance materials for health monitoring technologies.

11:00am **MD2-WeM-10 Functionalized Graphene for Sensor Applications***, Chi-Hsien Huang [chhuang@mail.mcut.edu.tw],* Ming Chi University of Technology, Taiwan **INVITED**

Graphene (G), a one-atom-thick, two-dimensional material, exhibits great potential as a biosensor transducer due to its high sensitivity to foreign atoms or molecules. However, its inertness limits its application, making functionalized graphene is very crucial for biosensor applications. In this presentation, I will talk about an atomic layered composite of graphene oxide/graphene (GO/G) by functionalizing chemical vapor deposition (CVD)-grown bilayer graphene (BLG) using our developed low damage plasma treatment (LDPT). This process selectively oxidized only the top layer of BLG, leaving the bottom layer intact. The GO top layer provides active sites for stable covalent bonding with biorecognition elements, while the G bottom layer acts as a sensitive transducer. With this GO/G composite, we constructed a solution-gated field effect transistor (SGFET)-based biosensors for miRNA-21, a cancer biomarker and p-tau 217, a Alzheimer's disease biomarker. In addition, laser induced graphene attracts a lot of attention because the preparation is low-cost, easy pattern fast and environment friendly. However, the electrochemical performance of standalone LIG is limited. To address this, the study enhances LIG by synthesizing nickel-iron Prussian blue analogues through co-precipitation and calcination, forming porous NiFe-Oxide, which is subsequently deposited onto the LIG surface via a facile physical deposition method. The porous NiFe-Oxide@LIG electrode material demonstrates excellent electrochemical sensing capabilities due to its high conductivity, improved surface area, enhanced active sites, and superior electrocatalytic performance for detecting the antioxidant propyl gallate (PG).

Keywords: graphene, LIG, sensor, biomarker

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Surface Engineering of Biomaterials, Medical Devices and Regenerative Materials
Room Golden State Ballroom - Session MD-ThP

Surface Engineering of Biomaterials, Medical Devices and Regenerative Materials Poster Session

MD-ThP-1 Electrochemical and Antimicrobial Coating: Increasing the Ionic Charge on Titanium Surfaces as a Preventive Strategy for Titanium Implants, ***João Pedro dos Santos Silva [jpedrooss85@gmail.com]**,* École des mines de Saint-Étienne, France*; Daniela Buenos Ayres de Castro, Mariana Mireski, Catia Sufia Alves Freire de Andrade, Maria Helena Rossy Borges,* Universidade Estadual de Campinas, Brazil*; Jean Geringer,* École des mines de Saint-Étienne, France*; Valentim Adelino Ricardo Barão,* Universidade Estadual de Campinas, Brazil

Peri-implant conditions and the electrochemical degradation of titanium (Ti) are critical factors in the failure of biomedical implant treatments. Developing functional surfaces to address these challenges is essential. Cationic coatings have proven to be an effective strategy for reducing biofilm formation and enhancing corrosion resistance. This treatment focuses on increasing the surface charge of implants and provides antimicrobial properties without the use of pharmaceutical agents, making the approach safer, more cost-effective, and sustainable. Thus, this coating was developed in two stages: (1) functionalization with hydroxyl groups (-OH) using plasma electrolytic oxidation (PEO), incorporating bioactive elements and enhancing surface functionalization; (2) silanization with tetraethylorthosilicate (TEOS) or 3-glycidyloxypropyltrimethoxysilane (GPTMS), which bind to alkaline surfaces and promote proton release through chemical reactions. Four groups (untreated Ti, PEO, PEO + TEOS, and PEO + GPTMS) were evaluated for surface characterization, electrochemical performance, and antimicrobial activity. Micrographs showed distinct morphologies in the silanized groups, with the alkalinization step generating pores that enhanced topography and roughness. The superhydrophilic affinity created by alkalinization evolved into hydrophobic (TEOS) and superhydrophobic (GPTMS) characteristics after silanization. The presence of amine groups, detected by X-ray photoelectron spectroscopy (XPS), indicated an increase in surface charge, confirmed by zeta potential measurements. Positively charged surfaces demonstrated superior electrochemical performance and greater antimicrobial potential against Streptococcus mitis biofilm formation (24 h). In conclusion, cationic coatings show promise for implantable devices, offering improved resistance in adverse environments and antimicrobial properties.

MD-ThP-2 Flexible, Enzyme-Free, and Ultra-Sensitive Cholesterol Sensor Based on In-Situ Etched $Ti_3C_2T_x$ MXene Nanosheets, ***Sanjeev Kumar [sanjeev.kumar@rgu.ac.in]**, Jyoti Jaiswal, Rajesh Chakrabraty, Kulsuma Begum, Bitupan Prasad,* Rajiv Gandhi University, India

This work presents an enzyme-free cholesterol sensor based on $Ti_3C_2T_x$ MXene nanosheets, offering a highly sensitive detection platform. The $Ti_3C_2T_x$ MXene nanosheets were synthesized via in-situ LiF/HCl etching, and the sensing electrode was prepared by drop-casting a colloidal solution of the as-synthesized MXene onto a paper substrate. To investigate the quality and properties of the synthesized $Ti_3C_2T_x$ MXene nanosheets, microstructural and compositional studies were conducted utilizing FESEM, XRD, Raman spectroscopy, XPS, and EDS. These characterizations confirmed the successful synthesis of the $Ti_3C_2T_x$ MXene nanosheets. Cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) were performed to analyse the electrochemical behaviour of the $Ti_3C_2T_x$ MXene-based electrode. The responses of the fabricated electrode to different cholesterol concentrations were recorded using CV in phosphate buffer solution, exhibiting robust linear response ($R^2 \sim 0.99$) in the range from 1 to 250 nM. The MXene-based electrode exhibited good sensitivity (0.75377 ± 0.01107 mF nM^{-1}), a low detection limit (0.07 nM), high selectivity, practical reproducibility, and excellent cyclic stability, suggesting its potential for real-time cholesterol monitoring in biomedical and healthcare applications.

MD-ThP-3 Effect of the Thickness of Fibrous Cap and Compositions on the Rupture Behaviour of the Atherosclerosis Plaques, ***Jiling Feng [j.feng@mmu.ac.uk]**, Mohamed Abdulsalam,* Manchester Metropolitan University, U.K.

Atherosclerotic plaque rupture is the leading cause of the cardiovascular diseases (CVD) such as coronary arteries disease, stroke and heart attack. Early detection of the plaques which are prone to the rupture, also known as vulnerable plaque, can provide important clinical information to prevent the fatal cardiovascular event. The vulnerable plaques are commonly characterized as the large lipid core and thin fibrous caps with the thickness less than 65 μm. However, evidence showed that plaques with fibrous caps > 65 μm are also susceptible to plaque rupture or erosion and can cause acute myocardial infarction and sudden death [1]. The effect of the critical thickness of fibrous cap and compositions of the plaques on the rupture behaviour of the arterial plaques has not been fully investigated. In this study, the artificial plaques with a variety of the compositions (lipid core, calcium and collagen) and with a range of thickness of fibrous cap were fabricated. The mechanical properties of the plaques were tested by using the unconfined compression testing. Meanwhile, the deformation of the arterial plaques samples and rupture behaviours were also recorded by using the high-resolution of camera. The initiation and propagation of the rupture of fibrous cap were analysed using digital image correlation (DIC) software. The experimental results indicated that the thicker the fibrous cap, the stiffer the arterial plaque. This phenomenon was observed in the plaques with large lipid core and calcified plaques. The Young's module for the plaques with large lipid core (Figure 1a) ranges from 0.0235 to 3.7174 MPa which are compatible with the value of plaques in the human carotid arteries which were observed in the clinical findings. The plaques with higher percentage of collagen possess the the greater Young's modules (Figure 1b).

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MD-ThP-4 Effects of Electrical Stimulation with Iridium Oxide Plasma Protein Hybrid Film on Nerve Cells, ***Po-Chun Chen [cpc@mail.ntut.edu.tw]**,* National Taipei University of Technology, Taiwan

Iridium oxide (IrOx) is a well-known material for neural stimulation, but its rigidity and lack of bioactivity limit its biomedical application. To address this, an IrOx film incorporating plasma proteins (IrOx-PP) was developed to enhance biocompatibility and promote neuronal growth. The addition of plasma proteins created bioactive sites that improved cell adhesion and differentiation while maintaining the electrochemical properties needed for neural stimulation. The IrOx-PP hybrid films showed significantly higher cell viability and metabolic activity, with electrical stimulation further enhancing cell growth and bioactivity. Neurite length increased significantly under electrical stimulation, with the IrOx-PP hybrid films showing the greatest enhancement. In addition, cells on IrOx-PP hybridfilms expressed higher levels of the neuronal markers, indicating their superior potential for promoting neuronal differentiation and neurite outgrowth compared to pure IrOx films. This result demonstrated that the IrOx-PP hybrid film can potentially serve as a platform for advanced neural interfaces, providing improved tissue integration.

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