Biomaterial Interfaces
Room Hall A - Session BI-TuA

The Future of Biointerface Science
Moderator: Tobias Weidner, Aarhus University, Denmark

2:15pm **BI-TuA-1 Quantifying Bacterial Adsorption at Biointerfaces Using Impedance Spectroscopy: A Key Step in Biofilm Formation***, Yunxing Li, Dipankar Koley,* Oregon State University

Bacterial adsorption is the first and important stage in the formation of biofilm on biointerfaces. A comprehensive understanding of this early stage of biofilm development helps us better control biofilm formation and evaluate the biointerfacical properties of various materials. To address the challenge of detecting subtle changes with this unstable bacterial adsorption in real time, here we developed a highly sensitive, flexible microsensor based on impedance spectroscopy to detect and quantify bacterial adsorption on different material surfaces using our innovative PEDOT coated electrode. These highly sensitive impedance electrodes gave a linear response to the amount of GFP-*E. coli*adsorbed. Furthermore, impedance-based methods enable monitoring of the kinetics of bacterial adsorption in real time. Utilizing this sensor, we observed stronger GFP-*E. coli* adhesion to positively charged glass than to regular glass. Additionally, we applied this sensor to metal ion-releasing resin composites to study how divalent metal ions (Zn^{2+}) control bacterial adsorption on these bioinerfaces. It not only allows for real-time quantification of bacterial adsorption, but more powerfully, it is capable of distinguishing between different material biointerface, which offers valuable potential for biointerface characterization.v

2:30pm **BI-TuA-2 Scalable and Biocompatible Polymer Dome Arrays for Oil-Free High-Resolution Live-Cell Imaging***, Kwang-Won Park, Sophie Liu, Wenjing Tang, Rong Yang,* Cornell University

High-resolution imaging of biological targets near the surface of glass coverslips conventionally requires immersion oil to match refractive indices and achieve optimal optical performance. However, this approach presents several limitations, including incompatibility with surface-sensitive cell types, potential cytotoxicity from oil infiltration into cell media, handling difficulties due to viscosity, and inapplicability with dry lenses. To address these challenges, we present a novel imaging platform based on polymer dome arrays (PDAs), nanoscale plano-convex polymer lenses fabricated via Condensed Droplet Polymerization (CDP), offering a scalable and biocompatible alternative to traditional oil-based systems. CDP enables rapid, vapor-phase production of PDAs with tunable sizes, radii of curvature, and surface densities directly on coverslips. The refractive index of the polymer material (n ~ 1.5) closely matches that of glass, eliminates immersion oil while enhancing diffraction-limited resolution. PDAs exhibited mechanical stability and optical precision during repeated imaging and confirmed biocompatibility with sensitive cell lines. To further enhance cell adhesion and minimize cytotoxic response, we applied conformal ultrathin polymer coatings atop the PDAs using initiated Chemical Vapor Deposition (iCVD) following CDP. These coatings significantly improved cell-substrate interactions while maintaining structural integrity and optical clarity over extended duration. This platform supports stable, long-term cell culture, allowing for real-time, high-resolution imaging at the single-cell level without reliance on immersion oil or advanced optical instrumentation. The combination of robust fabrication, superior biocompatibility, and optical performance positions this system as a versatile tool for live-cell imaging, mechanobiology, and high-throughput drug screening, where customizable, non-toxic substrates are essential.

2:45pm **BI-TuA-3 Development and Characterization of Decellularized Seaweed Scaffolds for Tissue Engineering.***, Gobinath Chithiravelu, Marion J. Jones, Ivana Hernandez de Estrada, Yadvendra Singh, Harish Subbaraman, Binata Joddar,* Oregon State University

In this study, the marine red seaweed *Devaleraea mollis* (commonly known as dulse) was investigated as a green, sustainable, and animal-free scaffold alternative, owing to its extracellular matrix (ECM) mimicking properties. A decellularization–recellularization approach was employed to develop cellulose-based scaffolds capable of supporting human cardiomyocyte growth. Native dulse samples were cleaned, dried, and decellularized using a combination of SDS (3, 5,7,10,12,15%), Triton X-100 (2%), and NaOCl (0.2%) in varying concentrations and time-dependent treatments. The resulting scaffolds were comprehensively characterized using light microscopy, scanning electron microscopy (SEM), Fourier-transform infrared spectroscopy (FTIR), and Raman spectroscopy to identify the conditions that best preserved the fibrous, honeycombed architecture and cellulose-rich content of the native tissue. Among the treated scaffolds, those processed with 10%, 12%, and 15% SDS concentrations demonstrated the most favorable outcomes. These selected scaffolds were then subjected to swelling analysis to evaluate biodegradation behavior, followed by in vitro cell culture to assess biocompatibility all tested scaffolds demonstrated excellent compatibility with human cardiomyocytes, maintaining high cell viability over at least one week of in vitro culture, as confirmed by immunohistochemistry, quantitative cell analysis, and SEM imaging. Notably, SEM revealed over 50% surface coverage by cells on the scaffold by day six, indicating robust cell attachment and proliferation. Collectively, these findings highlight seaweed-derived cellulose as a highly promising, biocompatible, and eco-friendly biomaterial posing itself a novel interface for diverse biomedical applications, including scaffolds for cultivated meat production and innovations in sustainable tissue engineering.

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