UC RIVERSIDE UNIVERSITY OF CALIFORNIA | Materials Science and Engineering

WINTER 2020 COLLOQUIUM SPEAKER

Design, Electrochemical Synthesis, and Characterization of Conjugated Polymers for Interfacing Biomedical Devices with Living Tissue

We are investigating the molecular design, synthesis, and characterization of conjugated organic polymers and copolymers for interfacing a variety of solid, hard, inorganic, metallic and semiconductor engineered electronic biomedical devices with wet, ionically-conducting, soft, living neural and muscular tissue. Specific examples of these devices include cardiac pacemakers, cochlear implants,retinal implants, peripheral nerve interfaces, and cortical microelectrodes. Recently we have been investigating the properties of copolymers prepared from chemically-functionalized versions of the 3,4-ethylene dioxythiophene (EDOT) and 3,4-propylenedioxythiophene (ProDOT) monomers. Examples of functionalities that we have explored include carboxylic acids, amines, aldehyde, enes, dienes, and maleimides. We typically use oxidative electrochemical polymerization so that the polymer deposition onto solid surfaces can be precisely controlled and monitored. Ene and dienefunctionalized copolymers can be subsequently modified with a wide variety of thiols using highly efficient thiol-ene "click" chemistry. We are also investigating branched variants of both EDOT and ProDOT to improve mechanical properties through crosslinking, as well as all-naturally derived materials made from electro-polymerizable biological monomers such as dopamine. These new monomers and their corresponding polymers require variations in the electrochemical deposition conditions, including alternative choices for solvents and counter-ions. We have characterized the resulting conjugated polymers using a variety of techniques including optical and electron microscopy, X-ray diffraction, electrochemical impedance spectroscopy, and biological activity assays. We have also examined their deposition in-situ by liquid cell transmission electron microscopy. These new materials make it possible for us to systematically tailor the stiffness and toughness of the conjugated polymers films, as well as their adhesion to solid substrates, their charge transport properties, their wetting behavior, and their specific interactions with cells.

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Prof. David C. Martin is Karl W. and Renate Böer Professor of Materials Science and Engineering and Biomedical Engineering at the University of Delaware. His research interests include the development of conducting polymer coatings for integrating biomedical devices in living tissue, high-resolution microscopy and impedance spectroscopy studies of defects in ordered polymers and organic semiconductors, and the deformation behavior of crystalline polymer and organic molecular materials near surfaces. He is a Fellow of the American Chemical Society, the American Institute for Medical and Biological Engineering, and the American Physical Society.

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