



MATERIALS SCIENCE and ENGINEERING SEMINAR

Co-Sponsored by: The Center for Research in
Soft Matter and Polymers (CRiSP)



Dr. Herdeline (Digs) Ardon

Chemical and Biomolecular Engineering

UC Irvine

Precision Engineering of Macromolecular Systems as Transducer Biomaterials

Signaling in physiological environments relies on ion currents, biomolecular exchange, and other physical cues that are all processed by the cellular machinery to execute a specific response. This presentation will focus on the development of macromolecular organic materials as ‘transducer materials’—materials capable of converting external or cell-mediated biophysical cues to stimulatory, regenerative cues or as sensory output signals—for electroactive living systems. Specifically, molecular engineering and fabrication approaches for endowing these systems with the order-dependent ability to convert exogenous optical, electronic, mechanical or chemical cues at the interface with excitable cells will be discussed. Soft lithography, nanoimprinting, surface templating, and light-based micropatterning techniques are leveraged to introduce topographical confinement effects on the self-assembly of optoelectronic peptide units on inorganic lattices or polymeric surfaces, consequently leading to tissue anisotropy. We elucidated the dependence of specificity of these surface-based assembly cues on the molecular design and size of the assembly units, as well as supramolecular distance to surface lattice matching. The peptide-polymer or organic-inorganic hybrid surfaces resulting from the templating process are capable of generating photocurrents upon excitation of the functionalized peptides. Additionally, we show the stabilization of these assemblies in aqueous suspension through complementary biomolecular motifs and on conductive polymer film substrates/ as hydrogels through surface conjugation chemistries. With these efforts, we have unraveled new insights on macromolecular assembly on surfaces, as well as how cardiomyocytes perceive the sub-micron dimensionality, local molecular order, and other surface cues from their immediate environment. Lastly, this presentation will cover biohybrid platforms of cardiac and brain models where the sequence-/chemical design-tunable polymeric or supramolecular assembly interface can transduce light to stimulate tissue function or drive spatial heterogeneity of model tissues. Overall, we envision these design-programmable and ordered transducer macromolecular systems towards promoting stem cell-derived cardiomyocyte maturation, facilitating regenerative processes, and advancing the capabilities of engineered tissue constructs for in vitro modeling applications.

BIOGRAPHY - Herdeline Ann (Digs) M. Ardoña is originally from Valenzuela City, Philippines. She received her B.S. in Chemistry from the University of the Philippines Diliman in 2011, completed her Ph.D. in Chemistry at Johns Hopkins in 2017, and was a postdoctoral researcher at Harvard University as an American Chemical Society (ACS) Irving S. Sigal Postdoctoral Fellow from 2017–2020. Currently, she is an Assistant Professor at the UCI Department of Chemical and Biomolecular Engineering, with joint appointments at the UCI Department of Chemistry and Department of Biomedical Engineering. She currently serves as a Senior Editor for the ACS journal Langmuir. She is named as an NSF CAREER recipient, Hellman Fellow, Kavli Frontiers of Science Fellow, ACS Polymeric Materials Science & Engineering (PMSE) Division Early Investigator, and named as one of the 2025 Talented 12 by the Chemical & Engineering News (C&EN).

**MSEG
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