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Design Principles of Mussel-Inspired Surface Primers with Catechol-cation Adhesion Synergy

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Abstract

Marine mussels rely on catechols and cationic amines to displace hydration layers and adhere to charged surfaces underwater. Mussel-inspired materials containing paired catechol and cationic functionalities are a promising class of materials for biomedical applications. Few studies address the molecular adhesion mechanism(s) of these materials. To better understand catechol-cation adhesion synergy, a suite of small-molecule adhesive primers was synthesized with systematic variations in the intramolecular spacing between catechol and cationic functionalities. The adhesion of these molecules to muscovite mica in an aqueous electrolyte solution demonstrates that increasing the intramolecular catechol-cation spacing preserves and in some cases enhances catechol-cation synergy.

Furthermore, I will present preliminary adhesion forces between symmetric thin films of collagen type-1 (Col-1) mediated by the highly adhesive mussel-inspired small molecules, called siderophore analogs. We show that siderophore analogs mediate robust adhesion between Col-1 substrates, a model for tissue. We further show that siderophore analogs can template collagen adsorption and inhibit Col-1 self-assembly, making the molecules attractive candidates for bio-functionalizing inorganic surfaces.

This knowledge will facilitate the design of new adhesives incorporating catechol and cationic functionalities for binding to negatively charged surfaces in aqueous electrolyte solutions, including metal oxide materials for medical implants.

About the Speaker

Dr. Roberto Andresen Eguiluz is an Assistant Professor in the Materials Science and Engineering Department at the University of California Merced since July 2019. He has a degree in Mechanical Engineering from the National Autonomous University of Mexico (UNAM), a Ph.D. in Materials Science and Engineering from Cornell University, and had postdoctoral appointments at the University of Illinois at Urbana-Champaign and the University of California, Santa Barbara.