UCMERCED | CHEMISTRY & BIOCHEMISTRY

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CHEMISTRY & BIOCHEMISTRY SEMINAR SERIES:

Surface-Guided Assembly of DNA Origami for Bottom-Up Nanofabrication

Abstract:

The development of nanoscale electronic circuits demands precise molecular positioning and control of surface interactions. My research focuses on the use of DNA origami as a programmable scaffold for surface assembly and nanoscale manipulation. My current research is directed toward understanding the site-specific deposition and early-stage mobility of DNA nanostructures under tunable ionic conditions, with the goal of using in situ Atomic Force Microscopy (AFM) to investigate how adhesion, diffusion, and alignment behaviors emerge during the deposition process.

Most previous DNA Origami Placement (DOP) studies have relied on ex situ measurements to optimize conditions such as origami shape, size, and Mg^{2+} concentration. While useful, these approaches offer limited insight into the real-time interactions that govern deposition dynamics. To address this gap, I plan to implement an in situ DOP strategy using nanopatterned self-assembled monolayers (SAMs) and AFM imaging, enabling direct observation of adhesion, diffusion, and alignment. This method offers a more accessible and cost-effective alternative to conventional nanofabrication techniques such as electron-beam lithography, which often require cleanroom infrastructure, expensive equipment, and long turnaround times. Preliminary results from our group suggest that this approach can achieve near-complete deposition yield with high alignment fidelity across different SAM configurations. Moreover, it opens the possibility for selective AFM-based nanomanipulation of deposited origami structures.

Overall, this research direction aims to generate foundational insights into DNA–surface interactions and programmable molecular assembly. By developing a flexible and mechanistically transparent platform, this work supports broader efforts in bottom-up nanofabrication and the integration of DNA-based components into future nanoelectronic systems.

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About the Speaker:

Originally from Mexico, Ivan earned his BSc in Chemical Biology and his MSc from the Universidad Autónoma de Baja California. He is currently a second-year PhD student conducting research in the Surface Materials Group led by Dr. Tao Ye.

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