



THE SALZBERG CHEMISTRY SEMINAR SERIES



The City College
of New York



Monday, April 24, 2023 @ 12:00 noon – MR1027

Charge transport and self-assembly at the single-molecule limit

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Abstract: Metal and covalent organic frameworks (MOFs and COFs) are distinct families of fundamentally molecule-based materials with permanent porosity. These systems exhibit record undoped conductivities up to $\sim 10^3$ S/cm, and are of growing interest for applications including electrocatalysis and chemical sensing. However, inherent experimental challenges have obfuscated their systematic electrical characterization, limiting progress. Indeed, bulk sample properties are strongly influenced by their preparation method, which dictate the crystal polymorph, number and type of defects, grain boundaries, and residual impurities. We are pursuing an alternative, “bottom-up,” approach to develop robust structure-property relationships in these materials by evaluating the conductance of framework-relevant structures in atomically-precise single-molecule junctions. We will present our investigations of charge transport across different linkage groups used in framework construction, as well as across relevant three-dimensional nodes comprising C, Si, and Os.

We will also outline strategies for the preparation of multicomponent self-assembled monolayers (SAMs). Such systems may be of interest, for example, to modulate the reactivity of surface-bound homogeneous catalysts by controlling their secondary coordination sphere. Our initial attempts to utilize redox-active metal bis(terpyridine) complexes as modular SAM building blocks has revealed important complications resulting from ligand dissociation and/or counterion loss, providing key insights that serve to guide subsequent directions.

Biography: Mike Inkpen obtained his Ph.D. from Imperial College London, UK with Prof. Nicholas J. Long and Prof. Tim Albrecht. He spent two years at Columbia University as a Marie Skłodowska-Curie Fellow, in the group of Prof. Latha Venkataraman. In October 2017 he returned to Europe for the final year of his fellowship, working with Prof. Philippe Hapiot at the University of Rennes. In January 2019, Mike joined the faculty at the Department of Chemistry, University of Southern California as an Assistant Professor of Chemistry. Research in the Inkpen lab focuses on molecular nanoscience, studying self-assembled structures such as single-molecule junctions and surface-bound monolayers whose function is strongly influenced by the properties of the incorporated molecule(s). These structures allow us, for example, to measure and manipulate charge transport through individual molecules (which may function as electronic circuit elements such as wires or switches), or to modulate chemical processes at solid-solution interfaces by controlling the nanoscale environment around reactive sites. The group has received funding from the American Chemistry Petroleum Research Fund (Doctoral New Investigator, 2021), and the National Science Foundation (CAREER Award, 2023).

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