New Redox-Responsive Molecular Tools and Larger Scale Systems for the Detection and Removal of Strategic Environmental Hazards

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The development of advanced materials, nanoscale structures and devices is often stimulated by the synthesis of new molecular constructs. Inspired by the famed 150-year-old compound commonly referred to as Wurster's reagent, Wurster-type receptors constitute a class of host molecules, discovered by our group, that contain the electrochemically-active phenylenediamine moiety within the receptor framework. Importantly, the phenylenediamine unit promotes strong interactions between the redox center and a variety of captured guests (cations, anions and electron deficient aromatics) using either a linking nitrogen atoms(s) or the electron-rich pi face. Modulation of the electrochemical properties via derivatization of the phenylenediamine core has created an electrochemical “tool box” which extends the range of guests that can be accommodated while maintaining the desirable electrochemical features. The possible combinations of phenylenediamine isomers, macrocyclic/ligand donor atoms and overall molecular topology endow these compounds with a rich coordination chemistry and promise in applications that include redox switches, sensors, transport agents, catalysis and molecular magnetism. In addition, receptor-modified surfaces, polymers and dendrimers extend the well-studied chemistry of the discrete molecular receptors toward the creation of devices for ultimate use in the detection, remediation and/or detoxification of environmental hazards. In this presentation, the synthesis, properties and coordination chemistry of representative members of the Wurster's receptors will be discussed with particular emphasis on the structure-property relationships involving receptor architecture, electrochemical properties, coordination chemistry and applications involving strategic targets.