Organic Ligand Design to Tailor Structure and Function of Surfaces: Single-Site Pt(II) Metal-Organic Chains at Surfaces by Redox-Active Assembly

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Combining the catalytic activity and robustness of heterogeneous catalysts with the high chemical selectivity of organometallic homogeneous catalysts is of high interest as we look to the next generation of catalysts. One route to achieve this goal is the formation and stabilization of well-defined transition metal single-sites at surfaces by coordination to carefully designed organic ligands, which we show can produce a well-defined oxidation state in weakly reducing metal sites. Recent results from our lab demonstrate the on-surface redox assembly of platinum with a dipyridyl tetrazine ligand on a single crystal gold surface. We have conducted experiments with several other ligands and metals, which will also be discussed along the theme of the critical aspects of the system design and on-surface assembly. X-ray photoelectron spectroscopy measurements demonstrate the metal-ligand redox activity and are paired with molecular-resolution scanning probe microscopy to elucidate the structure of the metal-organic network. In this presentation, I will also discuss other applications of supramolecular ligand design in the development of crystalline organic multilayer films with excellent charge transport properties and of anion-stimulated 2D crystal switching at the solution-solid interface. These studies open new opportunities in designing organic materials and metal-organic complexes at surfaces for organic semiconductors, sensors, photovoltaics, and catalysts.