HYDROTHERMAL SYNTHESIS OF ORGANICALLY-LINKED POLYOXOMETALATES

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Abstract

One of the thrust areas of our research deals with exploratory synthesis of new inorganic-organic hybrid materials for energy storage. It is well-known that relevant to the research described later in this thesis, inorganic-organic hybrid solids studied thus far are largely made of coordination complexes where the organic molecules are acting like a ligand to coordinate around metal cations. In this research, we will employ polyoxometalate (POM) anions as an inorganic building block to replace otherwise oppositely charged metal cations in hopes to synthesize extended hybrid frameworks with rich redox chemistry. POM clusters are made of aggregates of transition-metal (TM) oxide units and can be employed as a charge reservoir during multi-electron chemical reactions involving multiple TM cations. These inorganic clusters possess an unmatched range of physical (such as magnetism) and chemical properties, acting as a set of transferable building blocks that can reliably be utilized in the formation of new materials with desired functionalities associated with versatile electronic structures.15,16 One of the challenges is of course to imagine how these anionic clusters could interact with organic molecules that are necessary for the formation of new hybrids. We anticipate, therefore, that the 'coordination' chemistry between POM anions and organic molecules is going to be different than that observed in the conventional hybrids based on metal cations. This thesis study will take an initial step to explore this new chemistry and to illustrate the structure and bonding of resulting solids for our continued research development in POM-based hybrids. The major focus of my study is about the synthesis and characterization of new extended solids made of, more specifically, polyoxovanadate (POV) and 4,4'-bipyridine (bpy) organic molecules through self-assembly