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Orthogonal Metal Templating Strategies for the Synthesis of Poly[n]catenanes

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Polymers have the potential to benefit society in various ways such as health, safety, energy saving, and material conservation. The field of synthetic polymer chemistry has recently experienced rapid growth. With the continuing expansion of the material properties of polymers, an increased level of control over the underlying architecture of polymers is in great demand. A particularly relevant topic is the type of chemical linkage in the backbone of such polymers. The typical polymer contains a series of monomeric precursors covalently bonded to form either linear or branched architectures. These covalent bond linkages restrict the polymer, severely limiting flexibility. Although the usefulness of non-covalent mechanical linkages is clear, relatively little literature exists that explores it as a viable option for synthetic polymer chemistry. One type of non-covalent mechanical linkage consists of monomeric ring structures mechanically interlocking with one another to create a structure similar to that of an everyday chain. This category of molecules is called mechanically interlocked molecules (MIMs). The first MIM was made in the early 1960's with the synthesis of the first [2]catenanes, where [2] refers to the number of cyclic monomeric precursors [n] incorporated into the molecule. Though MIMs have been around for around 50 years, they were only starting to be used as subunits in polymers in the past two decades. This 30-year gap resulted from reports of poor yield in the synthetic routes that were explored to produce MIMs. Sauvage and co-workers broke this streak and revitalized the area of research by using metal-ligand coordination chemistry between Cu(I) and phenanthroline-based ligands to develop the first template-directed synthetic protocol. We plan on utilizing this orthogonal metal templating strategy to develop the first ever controlled synthetic route to a poly[n]catenane.