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INVESTIGATION OF WATER SOLUBLE COPPER ALKOXIDES,

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Metal alkoxides ($M(OR)_x$) are of interest for use in materials production due to their commercial availability, low decomposition, high volatility, high solubility, and many other tunable properties. However, these precursors are air sensitive or more appropriately water sensitive. For materials applications, we have shown that precursor structure plays a major role in dictating phase and shape of the resultant nanoparticles, so having control on the precursor's structure formation is very beneficial. Unfortunately, $M(OR)_x$ have small ligand charges in comparison to the large cation size of the metal. This leads to uncontrolled structure formation - hyperoligomerization. One way to achieve control is to use modifying ligands that can occupy multiple coordination sites. Cyclopentadienyl (Cp) is a ligand used in organometallic chemistry that prevents oligomers by occupying more that one coordination site on the metal center. A ligand such as Cp has not been elucidated for metalorganic compounds such as the $M(OR)_x$. Our research has focused on developing a $M(OR)_x$ using a group of ligands we call the H-OR* which includes: thiophene methanol (H-OTPM), tetrahydrofuran methanol (H-OTHF), and in particular pyridine methanol (H-OPy). These ligands are rigid, do not significantly deplete the charge, and have the potential to bind in a bidentate fashion. A novel group of $(OPy)_2Ti(OR)_2$ compounds have been synthesized and control of structure formation achieved. Surprisingly, several members of this family were found to be water soluble. Further exploration of OPy water soluble ligated species led to the study of $[Cu(OPy)_2]_2$ and $Cu(OPy)_2(HOPy)_2$. Each alkoxide was dissolved in water and the resultant product was found to be $Cu(OPy)_2{\cdot}4H_2O$ was obtained. Electrochemical investigations showed that $[Cu(OPy)_2]_2$ was able to catalyze oxygen reduction. Further optimization is underway to achieve more desirable voltages. Since the water soluble structure is known, it is of interest to determine if these novel precursors can be converted to nanoparticles using solution precipitation routes. The various synthesis, characterization, and properties of the Cu precursors will be discussed.

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