Research in the Pike Lab

What We Do:
Synthesis and characterization of inorganic complexes
• X-ray crystallography
• NMR ($^1$H, $^{13}$C, and $^{31}$P)
• Atomic absorption spectroscopy
• Infrared spectroscopy
• Thermogravimetry
• Fluorescence spectroscopy
• Crystallization
• Hydrothermal reactions
• Inert atmosphere methods
• Mass spectrometry

Research Goals:
• Environmental sensors
• Environmental control
• Photoemissive devices
• Optical data storage materials

Communication of Results:
• publication of results
• presentations at conferences
• annual research symposium
• weekly summer group meetings

An X-ray Structure: $[\text{Cu}_6\text{I}_6(\text{P(OPh)}_3)_6]$
Metal-Organic Materials

Metal-organic materials consist of metal ion “nodes” and organic or inorganic linker ligands (Lewis bases). They usually self-assemble from these components, forming molecules or polymeric networks.

Characteristics:
- Porous
- Reactive
- Redox active
- Chiral
- Photoactive

Applications:
- Separations
- Catalysts
- Sensors
- Displays
- Electronics
Network Types Vary with Metal-Ligand Ratio

Example: CuI networks with tetrahydrothiophene (THT)
Thermal Analysis

Percent mass loss determined using thermogravimetry (TGA), which is a microbalance in a furnace. In this case all final masses after THT loss closely match the theoretical mass value for Cul.
X-Ray Crystallography

Structure determination technique in which atom locations are determined through diffraction of X-rays from repeating atom layers in a crystal.
Our X-Ray Equipment: Bruker Apex DUO
Network Materials as Environmental Sensors

Copper(I) iodide produces a photoluminescence emission response with sulfur and nitrogen compounds.
Bi(III) Compounds in Pollution Control

Photoreduction of Bismuth produces radicals that can destroy organic molecules

\[ \text{Bi}^{(III)} + h\nu \rightarrow \text{Bi}^{(II)*} \]
\[ \text{Bi}^{(II)*} + RX \rightarrow \text{Bi}^{(III)}X + R^* \]
\[ R^* + RCl \rightarrow R_2 + \frac{1}{2} Cl_2 \]

Some bismuth complexes synthesized
Charge Transfer in Cuprate Salts

Pyridinium Iodocuprates

Orange = Cu
Purple = I

Pyridinium Iodo/cyanocuprates

Electron-deficient pyridinium cation
Electron-rich iodocuprate(I) anion

Visible light room temp.
365 nm light 77 K
Lanthanide ions are used as phosphors in LEDs. Enhancing their energy conversion would improve LED performance.

Aromatic rings in triphenylphosphine oxide (PPh₃O) ligand act as an "antenna" absorbing photon energy and transferring it to emissive f-orbitals in lanthanide ions via ligand-to-metal charge transfer (LMCT).
Contact Information

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