Synthesis of Fire-Safe Polymers For Aerospace Applications

Jack Y. Lu [UHCL]

Abstract
The proposed project will focus on the synthesis of new polymers that are suitable as fire resistant materials in aerospace applications. The increased utilization of polymeric materials in aircrafts interiors and passenger seats represents the largest source of potentially combustible materials. The success of this research will advance efforts to construct desirable fire-safe materials.

SYNTHESIS OF FUNCTIONAL MATERIALS REPRESENTS ONE OF the great challenges in current research. Coordination polymers have been found to own a wide range of applications such as molecular separation and pollution prevention in air, liquid, and water systems where they can be used as ion exchangers and molecular sieves. These materials may be used as fire resistant materials.

Experimental Activity, Results and Discussion
Among the new coordination polymers synthesized in our laboratory, [(H_2O)*Cu*(BPDC)] (2,2'-biphenyldicarboxylate)[1] is the first 1-D double-helical-chain coordination polymer based upon the binuclear square pyramidal *Cu*(II)-pair motifs synthesized under hydrothermal conditions and characterized by a single crystal X-ray diffraction technique (Fig. 1).

[*Cu*(IN)$_2$]·I_2[2] (IN = isonicotinato), the first removable solid-state iodine inclusion coordination polymer with an unusually stable eclipsed two-dimensional open-channel structure, has been synthesized under hydrothermal reaction conditions. The structure consists of square planar copper centers (Angles around the copper atom: *O*(1)-*O*-*O*(1) 180.00, *O*(1)-*Cu*-*N*(1) 88.94(11), *O*(1)-*Cu*-*N*(1) 91.06(11), *O*(1)-*Cu*-*N*(1) 91.06(11), *O*(1)-*Cu*-*N*(1) 88.94(11), and *N*(1)-*Cu*-*N*(1) 180.00º) coordinated by two pyridyl groups of two IN units and two bidenate carboxylate groups of the isonicotinato-ligand mono-dentated using one of the oxygen atoms. This square planar copper unit connects adjacent copper atoms to form square-grids where iodine molecules reside. The inclusion square-grid propagates to form an unusual eclipsed 2-D open-channel coordination polymer. Copper-copper separations in the square-grid channel are 8.849 × 8.771Å. The separation between the adjacent 2-D layers is about 3.629Å. Each iodine molecule has weak electrostatic attractions to oxygen *O*(2) atoms in the neighboring layers (2.947Å). The distance between adjacent iodine molecules is 5.795Å along each open-channel.

COORDINATION POLYMERS—Dr. Jack Yinglie Lu, Assistant Professor in the UHCL School of Science and Computer Engineering, devotes his research to a new type of polymer suitable for the fabrication of fire resistant materials viable in aerospace applications. New coordination polymers are synthesized in his laboratory.

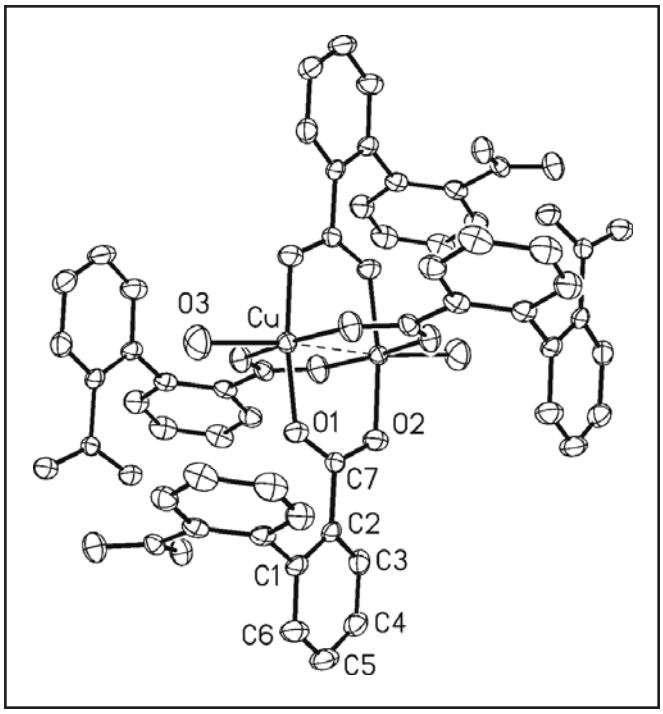

Figure 1. Characterization by a Single Crystal X-Ray Diffraction Technique

Thermal analysis revealed that the new complex started losing iodine at 190ºC; the framework is stable up to 300ºC.

This unique 2-D open-channel polymer remains stable after the removal of the iodine molecules from the open-channel of the eclipsed layers.

Acknowledgments
We thank the financial support from ISSO. This work made use of MRSEC/TCSUH Shared Experimental Facilities supported by the National Science Foundation and the Texas Center for Superconductivity at the University of Houston.

References
[1]J. Y. Lu and V. Schauss. "A Novel Double-Helical-Chain Coordination Polymer Constructed from 2,2′-Biphenyldicarboxylate-Linked Binuclear-Copper Motif," *Inorg. Chem. Commun*. 6.10 (2003): 1332-34.

[2]J. Y. Lu and A. M. Babb. "A Unique Eclipsed 2-D Coordination Polymer with Removable Iodine Molecules in the Open-Channel Structure," *Chem. Commun*. 12 (2003): 1346-7.

Publications
Lu, J. Y. "Crystal Engineering of *Cu*-Containing Metal-Organic Coordination Polymers Under Hydrothermal Conditions," *Coord. Chem. Rev*. 246 (2003): 345.