Icosahedral Boron Clusters: Building Blocks in Luminescent Materials

This presentation will describe the development of unique ligand scaffolds incorporating icosahedral carboranes, a robust group of organomimetic clusters that provide a variety of tunable frameworks not attainable with standard aromatic ligands, for use in luminescent transition metal complexes. Specifically, we have targeted blue phosphorescent Ir(III)- and Pt(II)-based emitters in the context of organic light-emitting diode (OLED) applications. OLEDs incorporating these types of emitters have achieved remarkable efficiencies in recent years, leading to the development of thinner and less energy-intensive television screens, mobile phone displays, and solid-state lighting sources. In order to realize the full potential of OLED-based devices on a global scale, critical issues related to efficiency and lifetime of blue OLEDs must be addressed.

We discovered a new class of highly luminescent bis(heteroleptic) Ir(III) complexes containing weakly coordinating nido-carboranyl substituents that associate with the cationic Ir(III) center through primarily electrostatic interactions. Importantly, the observed quantum yields for these complexes correspond to a 10-fold increase compared to those of previously reported Ir(III) complexes with carboranyl-based ligands featuring covalent interactions between the cluster and the Ir(III) center. In parallel, we have introduced a carborane-based ligand framework that involves the use of 1,1'-bis-o-carborane (bc) as a dianionic, strong field ancillary ligand in blue phosphorescent Pt(II) complexes. The bc ligand remains photophysically innocent in all visible transitions, and it provides sufficient steric bulk to preclude parasitic intermolecular Pt(II)···Pt(II) interactions. Additionally, we demonstrated that control over the mode of chelation of the bc ligand to the Pt(II) center enables the fine-tuning of the electronic properties of the resulting Pt(II) complexes by virtue of vertex-differentiated coordination chemistry of carborane-based ligands.

Finally, current progress towards luminescent metal complexes featuring multidentate carborane-based ligand architectures will be presented. This class of ligands should result in more rigid metal complexes with improved emission efficiency and greater stability. Ultimately, this work presents potentially new avenues for designing efficient blue phosphorescent emitters for OLED applications through the use of tunable carborane-based ligand scaffolds.

Presented by:

Kent Kirlikovali
Spokoyny Group

Department of Chemistry & Biochemistry
University of California, Los Angeles

Thursday, Feb. 14, 2019
2033 Young Hall
12:00 PM