Heteroleptic light-emitting copper(I) complexes with applications in light-emitting electrochemical cells

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The access to artificial light sources is one of the basic human needs and crucial for our modern society. As the energy to light conversion with "classic" lighting systems is relatively inefficient, the development of new lighting devices such as LECs (Light-Emitting Electrochemical Cells) and OLEDs (Organic Light-Emitting Diodes) promises considerable savings in terms of both energy and resources. The main advantage of this technology lies in the conversion of energy into visible light as main product instead of heat with light only as a by-product. Furthermore, the straightforward production of especially the LECs allows the cost-efficient production of light-emitting devices for miscellaneous application types. We present new results on the synthesis and investigation of light-emitting copper(I) complexes, which are a low-priced alternative to materials based on less abundant elements such as ruthenium or iridium. In order to stabilize the d^{10} state of copper(I) and protect it from being oxidized, the ligands should be coordinated in a tetrahedral geometry. Encouraging results have been obtained with P^P chelating bisphosphanes such as POP (bis[(2-diphenylphosphino)phenyl] ether) and xantphos (4,5-Bis(diphenylphosphino)-9,9'-dimethylxanthene), in combination with 2,2'-bipyridines, 2,2':6',2''-terpyridines and other chelating N^N-donors.[1,2] The copper(I) systems are very susceptible to the steric demand of the ligands. Due to sensible ligand tuning involving for example alkyl or aryl groups at the N^N ligands, we successfully prepared yellow emitting Cu(I) complexes with quantum yields of 37% and improving, with the respective LECs exceeding device lifetimes of 80 hours.[3]

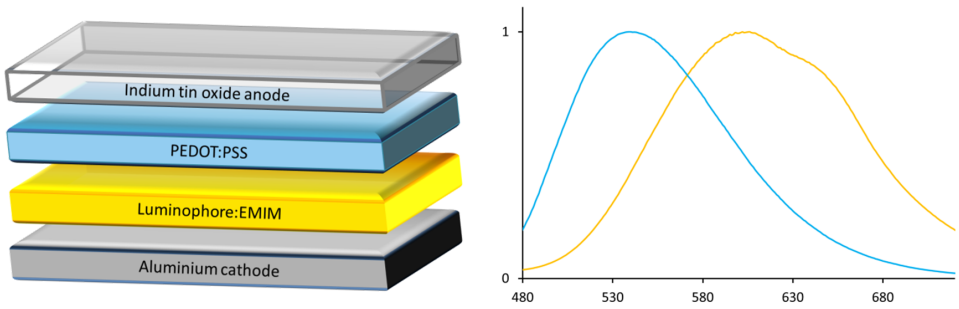

Figure 1. Left: Schematic buildup of a light-emitting electrochemical cell. Right: Normalized powder (blue) and solution (yellow) emission spectra of [Cu(xantphos)(6,6'-Me_2bpy)][PF_6].

The research on emissive Cu(I) compounds is very promising and still relatively new, leaving the field open for innovative ideas. Further alteration of the ligands will provide much needed insights into their influence on the important complex properties such as electroluminescence, lifetime of the excited state, quantum yield and ion mobility, thus allowing the fabrication of even more efficient light-emitting devices.

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[3] S. Keller, A. Pertegás, G. Longo, L. Martinez, J. Cerdá, J. M. Junquera-Hernández, A. Prescimone, E. C. Constable, C. E. Housecroft, E. Ortí, H. J. Bolink, *J. Mater. Chem. C.,* **2016**, 4, 3857-3871.