Development of copper-based light-emitting electrochemical cells: Sustainable metals for lighting

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Artificial light sources are crucial for our modern society, but due to the heat loss, the energy to light conversion with "classic" lighting systems is still 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. In this poster the synthesis and investigation of light-emitting copper(I) complexes will be presented, 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 enhance the emissive properties of the complex, 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].

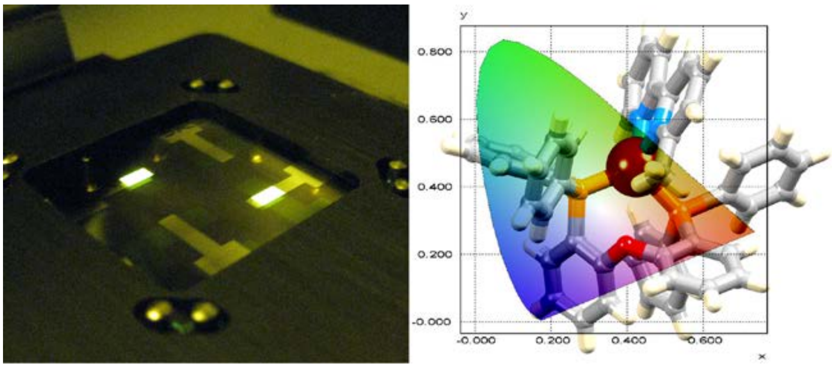

Fig. 1: Left: Light-emitting cell in operation. Right: Typical tetrahedral geometry of a [Cu(N^N)(P^P)]+ cation and CIE colour coordinates.

The copper(I) systems are very susceptible to the steric demand and electronic properties of the ligands. Due to sensible ligand tuning involving for example alkyl or aryl groups at the N^N ligands, we successfully prepared copper(I) complexes with quantum yields of 37 % and improving, with the respective LECs exceeding device lifetimes of 80 hours[3]. 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 stability, which then allows the fabrication of even more efficient light-emitting devices.

1 S. Keller, E. C. Constable, C. E. Housecroft, M. Neuburger, A. Prescimone, G. Longo, A. Pertegás, M. Sessolo, H. J. Bolink, *Dalton Trans.* **2014**, *43*, 16593-16596.

2 N. S. Murray, S. Keller, E. C. Constable, C. E. Housecroft, M. Neuburger, A. Prescimone, *Dalton Trans*. **2015**, *44*, 7626 – 7633.

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**, DOI: 10.1039/C5TC03725E.