Sustainable Materials Chemistry –Light-emitting electrochemical cells

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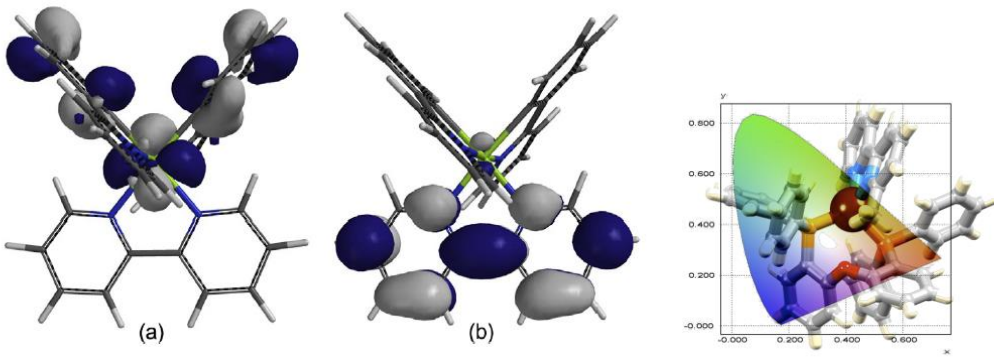
Mankind needs light. After the sun goes down, life continues as normal. In the evenings, our cities are lit up brighter than daytime. In Australia, lighting accounts for 10% of household electricity usage and 20–40% of commercial usage.

Lighting technology is changing. This talk concentrates upon the light-emitting electrochemical cell (LEC) which is a sustainable alternative to OLEDs. The devices are not dependent on the work function of the electrodes, allowing low-tech solution processing methods to be used for fabrication.

We have shown that iridium complexes of the type $[Ir(C\hat{}N)_2(N\hat{}N)]^+$ (C^N = cylometallated ligand, N^N = diamine) can be used to prepare LECs with long lifetimes (years) and high brightness. The lifetimes and turn-on times may be optimized by variations in the ligands, for example by introducing additional intramolecular π-stacking interactions which restrict excited state distortion. The HOMO and LUMO in the complexes are localized on the C^N and N^N ligands respectively, allowing ligand substitution to be used to tune the colour of the emission.

Although the fabrication processes are sustainable, the use of one of the rarest metals on Earth, iridium, is to be avoided. The second part of the talk concentrates upon the development of $[Cu(P\hat{}P)(N\hat{}N)]^+$ complexes (P^P = chelating diphosphine, N^N = diimine) to replace iridium species in LECs. Devices with improved lifetimes have been prepared, but the challenge of colour tuning remains.



Over the LEC rainbow: colour and stability tuning of cyclometallated iridium(III) complexes in light-emitting electrochemical cells, C.E. Housecroft, E.C. Constable, Coord. Chem. Rev., 2017, 350, 155-177: doi.org/10.1016/j.ccr.2017.06.016.