OPTOELECTRONICS

Ligands light up OLEDs

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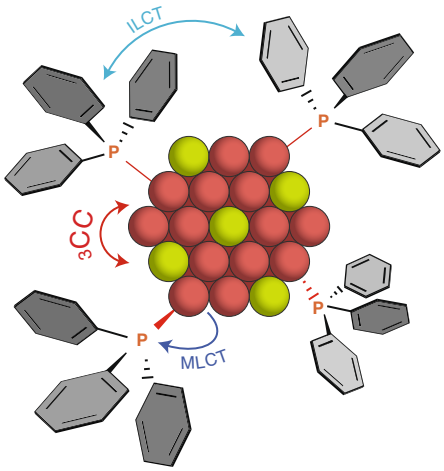

Clusters made from small ensembles of metal atoms can have unique optical properties. However, they often suffer from low efficiencies and can be difficult to integrate into optoelectronic devices such as organic light-emitting diodes (OLEDs). This is because the metal core of the clusters is typically stabilized by organic ligands, which limit the electrical properties. Guohua Xie, Hui Xu and colleagues have now developed high-efficiency blue-emitting OLEDs based on metal cluster emitters by using new methods of ligand engineering.

The researchers — who are based at Heilongjiang University and Wuhan University — began by using simulations to explore copper iodide (Cu_4I_4) clusters with different electron-donating ligands attached. The aim was to increase the component of radiative emission coming from transitions involving ligand-centred excited states, such as metal-to-ligand charge transfer (MLCT), while reducing the highly inefficient metal, or cluster-centred (CC), transitions. Because the metal cluster is involved in metal-to-ligand and cluster-centred states, they cannot be suppressed separately. However, through a careful cluster design and choice of ligand, Xu and colleagues were able to produce clusters that suppress the formation of cluster-centred states but also enhance the other ligand-centred emission, such as from ligand-to-ligand charge transfer (ILCT), to compensate for the decrease in the metal-to-ligand contribution.

The clusters were solution processed into blue-emitting organic LEDs, creating devices that exhibited a 30-fold increase in luminescence (to around 7,000 candelas per metre squared) and an 8-fold increase in internal quantum efficiency (to around 8%), compared with previous metal cluster OLEDs.

Matthew Parker

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