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Solution processable phosphorescent materials

P. L. Burn[(1)*], S.-C. Lo[(1)], W.-Y. Lai[(1)], J. W. Levell[(2)], I. D. W. Samuel[(2)] and J. P. Gunning[(3)]

(1) Centre for Organic Photonics & Electronics, University of Queensland, Queensland, 4072, Australia, e-mail: p.burn2@uq.edu.au
(2) Organic Semiconductor Centre, SUPA, School of Physics and Astronomy, University of St. Andrews, North Haugh, St. Andrews, Fife, KY16 9SS, UK
(3) Department of Chemistry, University of Oxford, Oxford, OX1 3TA, UK
* Corresponding author.

Abstract – Solution processable phosphorescent materials are required for large area displays and lighting based on organic light-emitting diodes. We have found that homopolymers with a 'phosphorescent iridium(III) complex' attached to every monomer unit can be solution processed. When the iridium(III) complex is at the core of a dendrimer side-chain the polymer becomes more easily processed from solution. The homopolymer comprised of dendronised side-chains can also be more easily blended with carbazole containing hosts to give films with enhanced performance.

The discovery that phosphorescent materials can give rise to the most efficient organic light-emitting diodes (OLEDs) [1] has caused an explosion of interest in the development of new materials. The majority of the effort has focused on small molecule emitters, which are processed by evaporation under high vacuum. Although this has been highly successful there are now concerns that the evaporation process might lead in some cases to the deposition of degraded materials. In addition, processing by evaporation is best suited to small devices.

To take phosphorescent materials into the realm of large area displays and lighting it would be advantageous to have solution processable materials. Phosphorescent dendrimers in which the phosphorescent emitter is encapsulated within a dendritic architecture has proved to be the most effective method for forming thin films for monochrome emission. Simple devices containing two layers, the emissive dendrimer layer and an electron transport layer, have been reported to have external quantum efficiencies of 13% at usable brightnesses [2]. However, the viscosity of such materials is not sufficient for them to be processed by methods such as ink-jet printing.

To overcome this limitation we have been developing phosphorescent poly(dendrimers). We have found that unlike previously reported copolymers containing small phosphorescent complexes it is possible to form homopolymers in which every 'monomer unit' has a phosphorescent moiety attached (e.g., **1** [3] and **2** in Fig. 1). In the homopolymers the close proximity of the phosphorescent emitters was found not to quench the luminescence in solution significantly, although in the solid state the intermolecular interactions do lead to a dramatic reduction in the photoluminescence quantum yield. By using dendritic emitters attached to the polymer backbone (e.g., **2** in Fig. 1) it was found that the homopolymer could be blended with carbazole containing host materials to give films with improved performance.

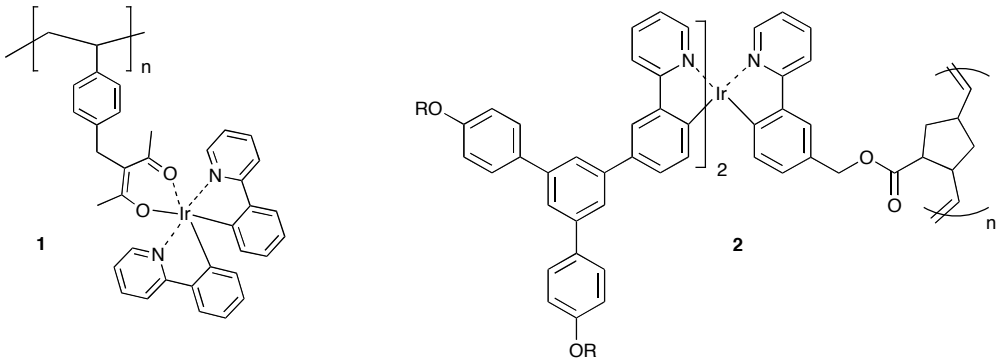

Figure 1: Structures of solution processable phosphorescent homopolymers, **1)** a polymer containing side chains comprised of a small molecule iridium(III) complex and **2)** a poly(dendrimer) with side-chains comprised of iridium(III)-cored dendrimers; R = 2-ethylhexyl.

References

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