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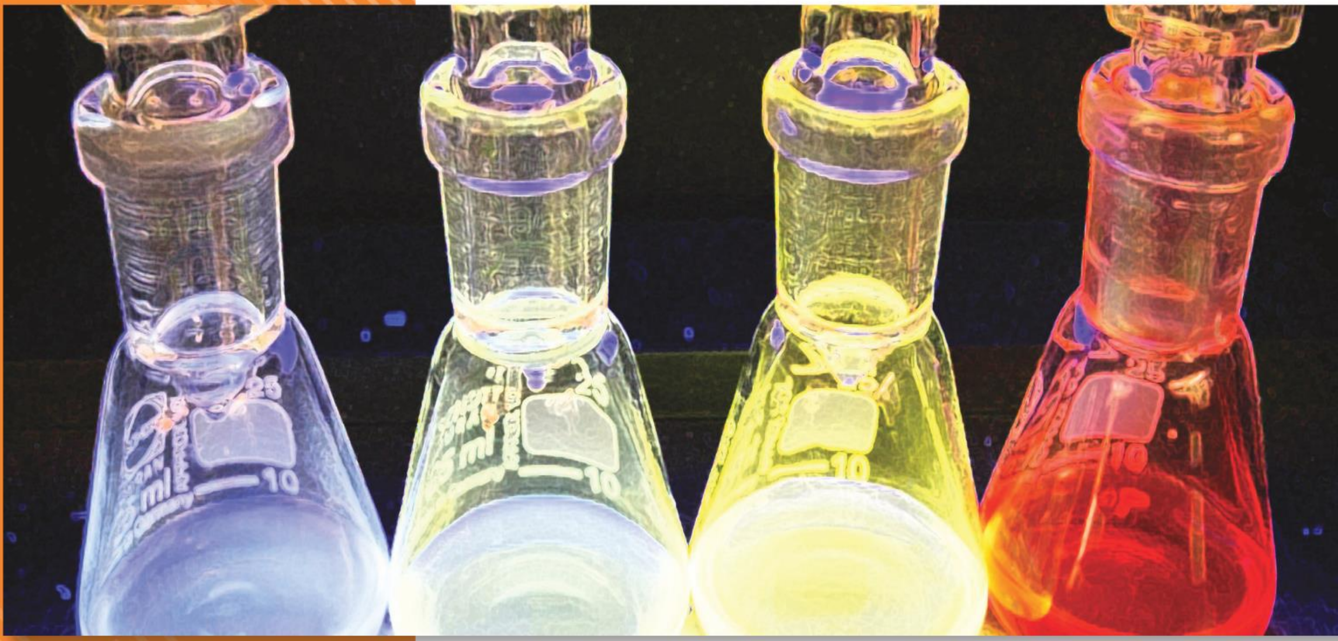

Materials Engineering of Integrated π-Conjugated Lumophore-Hybrid Spectral Converters for Next Generation Luminescent Devices

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Π-conjugated systems, such as conjugated polymers and organic dyes, are promising active components for organic solar cells, luminescent solar concentrators (LSCs) and light-emitting diodes. However, the optical and electronic properties depend explicitly on the arrangement and packing of the Π-conjugated species in the solid-state, which affects device performance. The incorporation of the Π-conjugated polymer or dye into an inorganic host, either through physical immobilisation or covalent grafting offers a mechanism for controlling its conformation and orientation, whilst simultaneously providing improved environmental stability. However, achieving homogeneous mixing at the macroscale can prove challenging due to the chemical incompatibility of the organic and inorganic species.

In an effort to overcome this, we have designed a series of Π-conjugated composite materials that utilise a family of organic-inorganic hybrid polymers known as the *ureasils* as the host. Ureasils are comprised of a siliceous skeleton that is chemically-grafted to poly(ethylene oxide) (PEO)/poly(propylene oxide) (PPO) chains through urea [NHC(=O)HN] cross-linkages, the number of which depends on the degree of branching in the organic polymer precursor. Ureasils are intrinsically photoluminescent, exhibit high refractive indices and function as optical waveguides. Through judicious selection of the degree of branching of the organic backbone and the incorporation method (grafting *vs* immobilization *vs* permeation), we can control the packing, orientation and placement of the Π-conjugated species in the ureasil host. This in turn provides a means of modulating the optical properties, *e.g.* a dramatic enhancement in emission quantum yield, colour tuning through energy transfer and improved light harvesting, which can be used to develop highly efficient LSCs to enhance the performance of silicon solar cells, or solid-state white light emitters for indoor lighting

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