Enhancement of Polymer luminescence by excitation-energy transfer from Multi-Walled Carbon Nanotubes

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Organic based solution processable devices are promising to revolutionise the lighting and photovoltaic industries of the future. The move away from traditional inorganic materials is driven not only by cost considerations, but also sustainability issues and life-cycle costs. However, current organic device efficiencies and lifetimes are not high enough for many applications.

One solution to improve the lifetime of these devices that has been investigated is incorporating carbon nanotubes in the polymer to form a composite. These "inorganics-in-organics" hybrid composites add many new dimensions and functionality to traditional organic films.

However, the addition of the carbon nanotubes typically comes at a cost. For example, in light emitting materials, the presence of the carbon nanotubes (CNT) reduces the emission from the composite, due to quenching of charge carriers at the nanotubes, which are generally metallic in nature for multi-walled CNT. This quenching reduces the emission efficiency of the devices.

Researchers at the Advanced Technology Institute of the University of Surrey, in collaboration with researchers from China and the USA, have recently demonstrated that this quenching effect is not an unavoidable problem. In fact, they demonstrate a 100-fold increase in the light emission from a nylon polymer sample, by incorporating multi-walled

carbon nanotubes (MWCNT).

This increase in light-emission only occurred when they acid treated the MWCNT prior to inclusion in the polymer. They propose that this increase is due to a novel energy transfer mechanism, from the acid-damaged surface of the MWCNT to the emitting sites in the polymer (see figure below.) In addition to the enhanced light-emission, the study also demonstrates that the MWCNT produced an improvement in the stability of the polymer to light-induced degradation.

Dr. Simon Henley, one of the lead investigators, comments "These results show that carbon nanotubes have enormous potential as a versatile material in future optoelectronic devices, and raise the prospect of utilising MWCNTs to harvest solar radiation in organic solar cells, in addition to improving device stability. "

Professor Ravi Silva, Director of the Advanced Technology Institute states: "The mere fact that now we can have a predictable organic-nanotube hybrid composite, with enhanced properties should open the door for many new applications. The enhancement in the luminescence properties bodes well a new generation of organic devices that could potentially reach commercially viable figures of merit for large scale production. We are very excited with these initial results".

'"The work conducted at the ATI will now allow us to investigate ways to modify the active material used for solar cells in order to harvest more of the solar spectrum using hybrid mixtures.'

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Source: University of Surrey