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Super-efficient quantum dot enhanced LEDs and photovoltaics.

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LED technology has not changed significantly over the last decades despite a drive to improve efficiency for general lighting and display applications. Recently the advent of quantum dot material provides an exciting new way to improve efficiency and colour quality. In this talk I present groundbreaking work on quantum dot enhanced photonic crystal LEDs and solar cells.

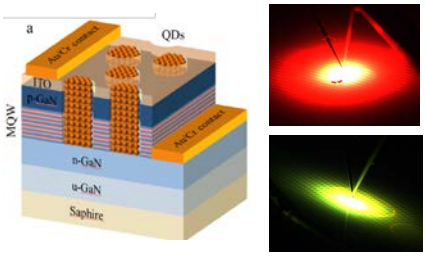

Figure 1. Schematic of Quantum dot enhanced photonic crystal LED, and photographs of light emission.

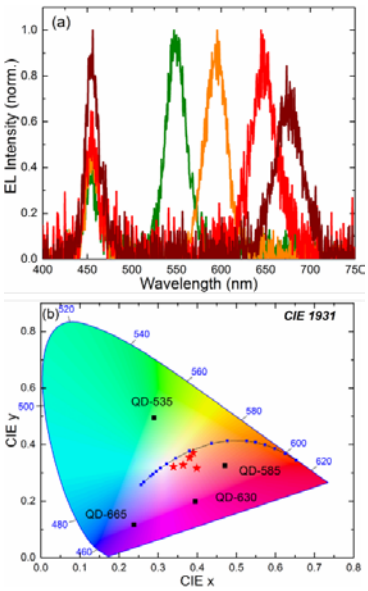

Figure 2. Multicolour emission spectra for segmented LED, and tunable CRI colour coordiantes.

By modifying the device configuration of an LED, we change the energy conversion process which generates light, and engineer conventional loss mechanisms out of the device. We increase colour conversion efficiency from the benchmark of around 35% provided by a regular LED to an equivalent of 110% [1]. This is achieved not by breaking the rules of physics but by harnessing two additional energy conversion processes (photonic quasi-crystal [2] light extraction, and Resonant Energy transfer) as opposed to just luminescent colour conversion to give phenominal performance improvement. I present demonstrator LED devices, and describe work towards creating a super-high efficiency micro-LED display for 3D virtual reality applications and projection systems such as head up displays. I also present work and recent results using this technology to boost silicon solar cell efficiency by 18%.

References

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