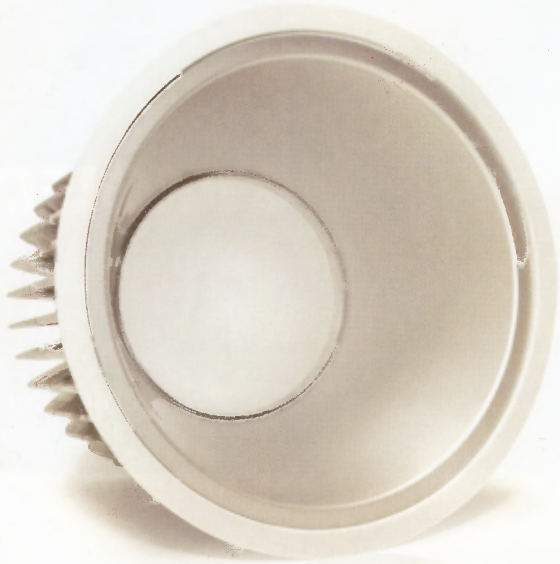
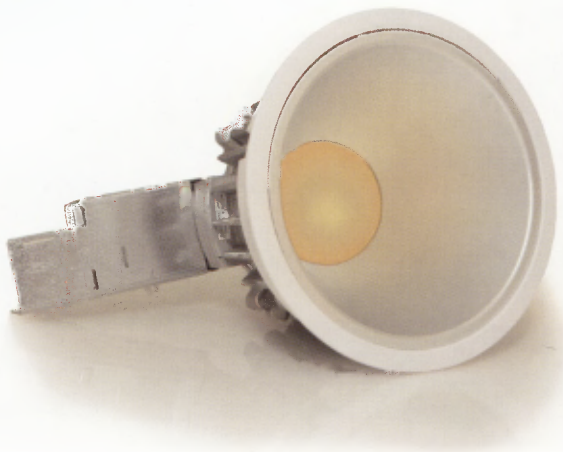
CRYSTAL CLARIFIED

David Morgan takes a look at NN Crystal's latest developments in quantum dot technology - the Qshift Coral and Qshift Lucid - on show at this year's Lightfair





Hidden away in the Renaissance Lighting booth at the recent Lightfair show in Las Vegas was an interesting combination of optical innovation and nanotechnology from two different companies collaborating to improve the efficiency and quality of white light from LED sources. The luminaire innovation came from Renaissance Lighting while the nanotechnology innovations were provided by NN Crystal.

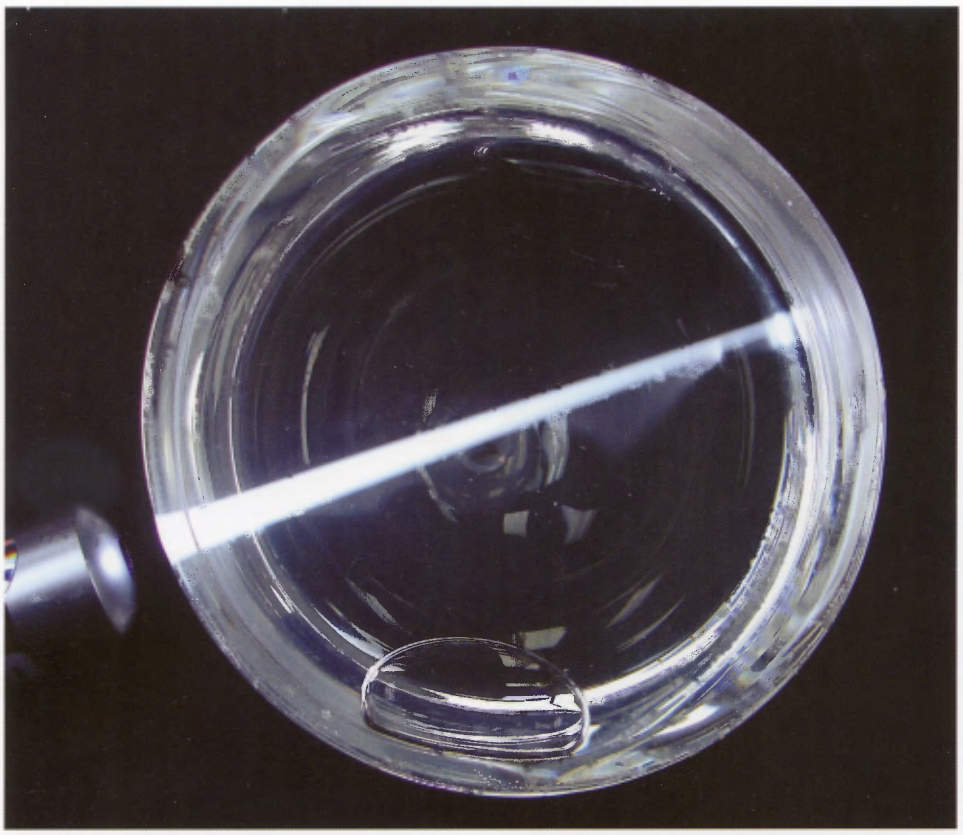
Renaissance Lighting was formed to commercialise optical research work that had been inspired by research into laser-guided weapon countermeasures. The company was launched in 2005 and the key products are downlights incorporating their patented Constructive Occlusion technology. This is an indirect system whereby light from a number of LEDs is combined in a reflector mixing chamber to produce a low glare and consistent colour white or colour changing light source. Renaissance downlights also incorporate other patented design features to maintain light output over the life of the luminaire and to control colour temperature.

NN Crystal is a division of NN Labs founded by professor Xiaogang Peng who was professor of chemistry at the university of Arkansas. The synthetic techniques used to make semiconductor nanocrystals that Dr. Peng pioneered are now the standard used by all quantum dot manufacturers worldwide.

One application for Colloidal nanocrystals (also known as quantum dots) that NN Crystal have developed is in LED lighting to convert blue or violet light from high power LEDs into good quality warm white light. NN Crystal claim that this process will be up to 40 percent more efficient than using the current LED design approaches where blue light is converted into white light using yellow phosphors. Not only will the use of quantum dots be more efficient but it will also produce more stable colours than phosphors and will be less affected by high temperatures. Colour point stability in a fairly high temperature environment over a 50,000 hour life is one of the key issues with LED lighting and the remote phosphor approach incorporated in the Xicato, GE Vio and Philips Fortimo LED arrays is one solution. Quantum dots would appear to be another perhaps more effective solution to this problem of colour shift during life.

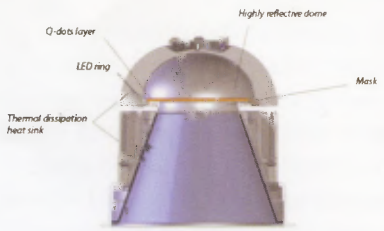
At Lightfair NN Crystal were showing two implementations of their technology; Qshift Coral and Qshift Lucid. With the ability to finely tune the light, Qshift Coral uses conventional colloidal nanocrystals (quantum dots) that allow the color of the light to be precisely controlled. Qshift Coral technology makes the lighting warmer and with improved light quality, while reducing its energy consumption for the same Lumen output compared with traditional phosphor-based warm white lighting.

Qshift Coral has already been incorporated into the Renaissance range of Solia downlights that were presented at Lightfair this year. Renaissance claim that the incorporation of this technique has increased Lumen output by over forty five percent with six percent better efficacy while maintaining a CRI of 80. Apparently in a side-by-side



This page Shown at Lightfair, though still at the prototype stage, NN Crystal's Qshift Lucid module – a clear glass domed enclosure containing a clear liquid – transforms blue or violet light into a warm white colour

Opposite The Qshift Coral has already been incorporated into Renaissance Lighting's Solia range of downlight, presented at this year's Lightfair



comparison with three industry leading LED downlights, Renaissance Lighting's Solia downlight scored highest on delivered light levels and efficacy.

The design of the Renaisisance Solia downlight with its mixing chamber and indirect light path was an ideal test bed for the addition of the NN Crystal nanotechnology as there was already space for the Qshift Coral to be accommodated.

Qshift Lucid is the next stage in the development of quantum dots and is a unique patented technology that does not use heavy metals and provides a high performance and neutral coloured alternative to existing rare-earth phosphor materials. This is still at the prototype stage and the aim is to launch products incorporating this technology in time for Lightfair 2011.

The Qshift Lucid modules shown at Lightfair are somewhat like a traditional snow scene paperweight - a clear glass domed enclosure containing a clear liquid - the magic is that when blue or violet light is directed through the liquid the light that comes out is transformed into a warm white colour.

Apparently the most efficient wavelength for LED's to produce is purple light at 405nm nanometers. This is the same colour light used in the GE Vio LEDs with their remote phosphor dome. This wavelength is also understood to be the most stable during the life of the LED and thus make the ideal starting point for a high efficiency LED lighting system.

It is difficult to make any predictions how this approach to converting purple LED light into white light will develop over the next few years since it is at an early stage and production costs are based on low volumes . I presume that the phosphor manufacturers are hard at work improving their materials and since these are based on the well established phosphors used in fluorescent lamps so the high volume, low cost production facilities already exist and the materials are relatively cheap. However the inclusion of heavy metals including cadmium and mercury in the phosphors used in white LEDs is a concern and undermines some of the green credentials that LED lighting claims for itself.

There may also be design issues with the use of liquid nano particles that need to be overcome - the module fits nicely into the Renaisance downlights with a 4 inch cone reflector but would it work as well in a 50 mm diameter size downlight and how effectively can it be incorporated into an adjustable spotlight design?

It is exciting that LED lighting is still in such a fast developing phase and the efficiency and quality of light is improving so quickly. Whether quantum dots will play a major role in the next stage of development of LED lighting is yet to be decided but NN Crystal are certainly working hard to ensure that the future looks rather dotty.

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