FEELgiantQDs
FIELD EMISSION EFFICIENT LAMPS OF GIANT QUANTUM DOTS

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Project context and objectives

In our proposed lighting devices, the primary excitation source is electrons. Basically, the electrons are produced by a field emission lamp. The generated electrons then excite the ZnO nanorods, which will serve as electron to UV converter. Finally, the generated UV light is absorbed by the giant colloidal quantum dots (giantQDs) and converted to visible photons. The giantQDs were selected because of their high stability and control of the emission spectrum.

Our basic strategy is to construct the front electrode using ZnO nanorods combined with the UV converter enabling very high internal quantum efficiency. Then the giant QDs are coated on the walls of the transparent glass. Finally, the resulting FEELgiantQD devices will be tested and evaluated in several prototypes manufactured by LIGHTLAB.

Here our scientific objective is to demonstrate a proof of principle field emission efficient lamp of giant QDs with a luminous efficiency of >100 lm/W and a color rendering index (CRI) of >90, maintaining temperature resistance for a lifetime of >50,000 hours.

Brief description of the main results

Bilkent group has synthesized the colloidal quantum dots using SILAR technique with high efficiency and large shell thickness for high stability. The detailed characterizations of the synthesized quantum dots have also been carried out. The quantum dot films were prepared on the samples received from KTH group and the films were sent to KTH for further testing and feedback.

Final results, potential impact and use

The giant QD's have been tested for direct conversion, i.e. light emission generated directly by electrons genertade in a vacumm system using ane electron gun in the energy range of 2-6kV as well as with a CNT (Carbon Nano Tube) emitter at 500V. The QD's convert the electron energy into light directly, however the efficiency seem to be low. More work is needed in order to optimize this.

For general lighting applications, these kind of materials may, when used in a field emission lamp, enhance the energy efficiency significantly and will if successfully developed play a clear role in the phase out of mercury. In the EU alone the potential savings in energy would be some 10-15B kWhrs per year if utilized to its full potential.