BA/FP/MA

Angle resolved intensity and wavelength measurements on silicon nanocrystal light emitting diodes

Organic light emitting diodes (OLEDs) are already in mass production but they can still be improved in terms of power efficiency and narrow emission spectra. In this connection, quantum dot LEDs (QLEDs) are an interesting alternative to organic light emitters because they show a narrower emission spectra combined with a potential flexibility of the OLEDs. The drawback of the commonly used II-VI and IV-VI nanocrystals is that they are based on Cd or Pb, for example, CdSe and PbS and therefore they are toxic. Since the European Union wants to reduce the amount of toxic materials in consumer electronics, alternatives are needed. Silicon as bulk material is not suitable for LEDs due to its indirect bandgap, but while shrinking silicon below the Bohr radius, the silicon nanocrystals (SiNCs) form a quasi-direct band gap and show strong photoluminescence. The emitting wavelength can also be tuned across the spectrum by varying the size of the nanocrystal or the functional surface groups.

Light-emitting polymers or nanoparticles are usually non-monochromatic emitters, as their valence and conduction bands are not sharply defined. The suppression of one emission wavelength by destructive interference can change the color and intensity and is dependent on the viewing angle. The aim of this BA/FP/MA project is the measurement of the emission wavelength and intensity depending on the viewing angle. You will learn how to fabricate the SiNC-LEDs and how to characterize them. The used SiNC-LED device structure is shown in Fig 1. For encapsulation, a thin glass slide is glued on top of the LEDs, which you can see partially on the photo of the working LED. For performance investigation, the luminance and current density will be measured while sweeping the applied voltage. In the next step the viewing angle intensity and color is measured and finally the EQE will be calculated. Additionally, basic layer characterizations methods will be performed as for example layer thickness profilometry.

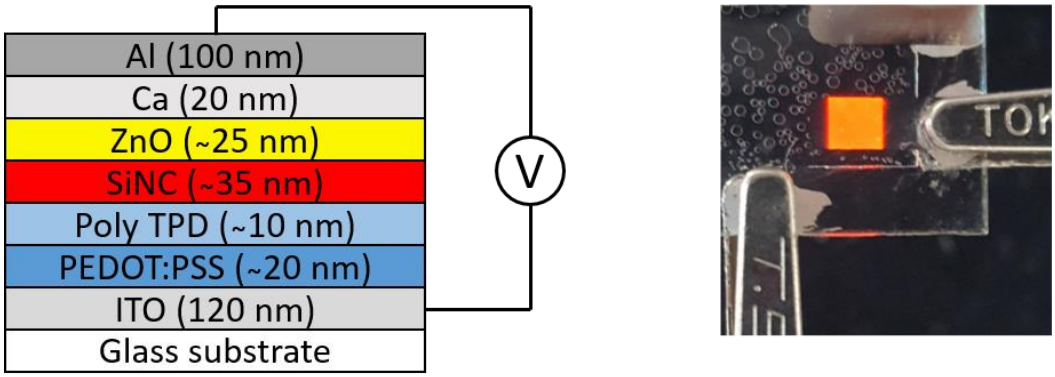

Figure1: Used SiNC-LED stack with the target thicknesses of each individual layer and a photo of a working SiNC-LED

If you are interested and for further information, please get in contact with Josef Mock, josef.mock@tum.de