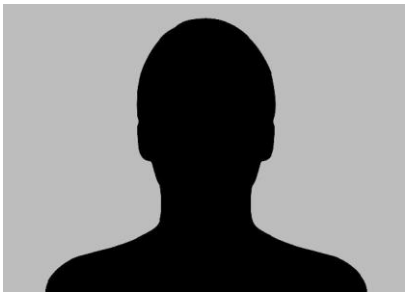
Zurich University
of Applied Sciences

School of
Engineering

ICP Institute of
Computational Physics

Optical Modelling of Quantum Dot Films for Display Applications



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Quantum dots (QDs) have gained increased attention as a promising solution for display applications with a wider color gamut, narrow wavelength, high quantum efficiency, and tunable absorption-emission wavelengths in UV-Vis range. Due to these advantages, they can been applied as optical down-conversion layers in display applications. As illustrated in Figure 1, QD down-conversion means that QDs absorb light at a shorter wavelength (blue) and emit light at a longer wavelength (green). The aim of this thesis was to optimize the material parameters via simulation to achieve a high down-conversion efficiency.

First, we report on measuring the optical properties of QD films with angular dependent spectroscopy. Next, optical modeling for QD down-conversion film with simulation software Setfos using a ray-tracing algorithm was performed to investigate the influence of key material parameters. Moreover, unknown material parameters were optimized with Matlab using a pattern search algorithm to obtain a good agreement between simulations and measurements. Figure 2 shows the good agreement between the simulated values and the measurements on a QD film that was fabricated in our laboratory.

The performed work proves that the optical model for QD down-conversion and scattering events in Setfos is valid. Moreover, this paves the way to perform the optical modeling of QD films with a systematic variation of material parameters in a next step. This can help display manufacturers to investigate the influence of material parameters and achieve their color coordinate targets for display applications.

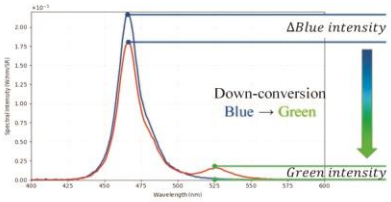

Fig 1 Illustration of optical down-conversion: blue light is absorbed in the QDs and emitted as green light.

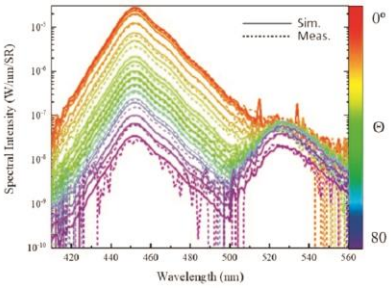

Fig 2 Measured and simulated luminescence spectra of a QD film fabricated in our laboratory.