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(POS-32) Towards the hyperspectral Investigation of Individual Fluorescent Quantum Dots via Scanning Near-Field Photoluminescence Spectro-microscopy

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Quantum dots (QDs) are solids confined at the nanoscale in all directions, which often enables them to exhibit photoluminescence (PL) even if their long-range crystalline counterparts do not. QD-PL is essential to explain the different roles of confinement in these nano-objects. To gain insight into the luminescence of individual QDs, optical probes potentially capable of resolving the emission signal from individual nano-objects are required, which avoids the effect of radiative energy transfer between neighboring QDs, or to the environment. To this end, we developed a hyperspectral scanning near-field optical microscopy (SNOM) PL imaging system. SNOM utilizes evanescent radiation to generate optical excitation and/or capture luminescence signals at lateral resolution beyond the diffraction limit that restricts the optical resolution of plane-wave propagating radiation. Our hyperspectral imaging apparatus was tested on calcium-zinc oxide luminescent QDs embedded in commercial scotch tape to make it fluorescent. Investigation of this scotch tape including Rutherford backscattering, scanning electron microscopy, and energy dispersive x-ray spectroscopy, were performed to determine the tape morphology and composition which was found to be (Ca0.95Zn0.05O):(C8H10O)20 consistent with literature reports of CaZnO QDs embedded in a polymer matrix (i.e., the tape itself). Using our scanning hyperspectral system, PL spectra from the tape were recorded using 405-nm excitation on a 10x10 um area at 200 nm pixel size, and the PL emission peak was found at 560±10 nm, which is significantly different from the 590–620 nm range expected from "macroscopic"PL measurements. The observed PL emission wavelengths are in line with the results from CaZnO as reported in the literature. With a deeper understanding of the root causes of the differences between nanoscale and "macroscopic"PL measurements, our hyperspectral tool will invaluably further our knowledge on the relationship between quantum and dielectric confinements as a function of QD diameter, distribution, and luminescence intensity.

Keyword-1

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Keyword-2

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Keyword-3

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