Enhancing Luminescence Efficiency of Quantum Dot/Polymer Films via Surface Functionalization of Quantum Dots for White Light Emitting Diodes

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We investigated the change in quantum yield of quantum dots (QD) / polydimethylsiloxane (PDMS) composite films by surface functionalization of CdSe/ZnS core/shell QDs with different surface ligands. We use five different thiol terminated ligands containing ethoxy, ester, and alkyl groups with varying chain lengths for surface functionalization. Under minimum influence of quantum yields by the surface ligands in suspension, QD/PDMS composite film appeared to exhibit various quantum yields depending on the surface ligands on QD. We found that the quantum yield of the composite film containing QDs functionalized with the longest alkyl chain exhibited the highest quantum yield whereas that with the ester-functionalized QDs the lowest. This was attributed to a difference in spatial dispersion of QDs in the polymer films, as visualized in three dimensional confocal microscopy. We fabricated white LEDs by stacking red- and green-emitting QD/PDMS composite films onto blue LEDs: the longest alkyl chain-functionalized QDs exhibited superior luminescence over the unfunctionalized QDs.