Functionalization of Quantum Dot Ligands for Efficiency and Stability Improvement of Color Conversion Films in Display Devices

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In this work, we propose novel ways to functionalize QD ligands and to induce chemical reaction between QD ligands and polymers. The reactive functional groups such as hydroxyl and acrylate groups were introduced without any degradation in optical properties. The synthesized QD ligands were characterized by spectroscopies and it was verified the reaction was controlled quantitatively. The functionalized QDs having terminal hydroxyl or acrylate groups were formed to three types of QD-polymer matrices with covalent bonds between the QDs and polymer components to improve efficiency and stability of QD films. The first is the hydroxyl terminated QD and reacts with long chain spacers. The designed film showed 26% higher quantum yield than the conventional QD films. In the second, QD-siloxane films were fabricated by hydro-silylation between the acrylate terminated QD and siloxane precursors. The QD-siloxane film showed 22% and 45% higher stability in harsh conditions. With the third, the acrylate terminated QD was formed QD-polymer beads via suspension polymerization and the bead showed 7.2 times higher stability than QD-PMMA matrix.