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Semiconductor Quantum Dots—Polymer Composites for Hybrid White Light Emitting Devices

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The synthesis of a (CdSe)ZnS quantum dot-polymethylmethacrylate polymer composite and the fabrication of QD-polymer composite films are described. CdSe and (CdSe)ZnS quantum dots were produced by direct colloidal chemical synthesis and the surface-passivation method that involved an overcoating of the dots with a larger bandgap material. The photoluminescence quantum yield of core-shell quantum dots was greatly enhanced by an overcoating which reduced the surface states or surface defects. PMMA is transparent in the visible spectral range and was chosen as an embedding matrix for the QDs. A 28%(w/w) of PMMA in MMA was the most appropriate concentration for producing a film of good quality and to maximize the solubility of quantum dots without phase separation of the QDs from the matrix. Green or red light emitting (CdSe)ZnS QDs-PMMA polymer composite films were prepared by combining the green or red light emitting (CdSe)ZnS dots with PMMA of high optical transparency in the visible region and spin-coating the composite solution. The fabricated green light emitting (CdSe)ZnS-PMMA composite film had a good quantum yield of 40% and a narrow emission band at 543nm with a full width at half maximum of ~ 35nm at room temperature. We fabricated a white light emitting devic by combining the green/red light emitting QD-polymer composites with the blue light emitting LED as an excitation source. The QD-polymer composites described here can be also used in flexible full color display applications.