Quantum Dots for automotive lighting systems

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Semiconductor quantum dots (QDs) have emerged as promising materials for advanced automotive lighting technologies due to their tunable optical properties, narrow emission bandwidth, and high photoluminescence efficiency. In this work, we present the experimental design and fabrication of photoluminescent QD-based composite films for automotive optoelectronic applications. The study focuses on the synthesis of environmentally compliant core-shell QDs and their integration into transparent polymeric matrices to develop efficient light-conversion layers suitable for next-generation vehicle lighting systems.

Colloidal synthesis methods were employed to produce InP/ZnS core-shell QDs as cadmium-free alternatives compatible with current environmental regulations. ZnS shell growth was used to enhance surface passivation, improving photoluminescence quantum yield (PLQY) and chemical stability. The purified QDs were subsequently dispersed into transparent polymeric matrices, including PMMA and epoxy resins, to fabricate luminescent thin films. Controlled curing processes were optimized to preserve the optical performance of the QDs while ensuring homogeneous film formation. The resulting QD-films will be evaluated under conditions relevant to the automotive industry, including luminance uniformity mapping, accelerated thermal cycling, UV exposure, and humidity stability tests to assess thermal quenching and environmental degradation effects.

The developed materials demonstrate the potential of QD-polymer composites as efficient spectral conversion layers capable of transforming blue LED emission into high-purity white or customized colored light for automotive applications. This work contributes to the development of energy-efficient and durable optoelectronic materials within the framework of the UGR-Valeo Chair.

Keywords:
Quantum Dots, Lightning, Automotion

References:

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