

Área: MAT

Fluorophosphate glasses containing CdS quantum dots: Synthesis, characterization, and photoluminescence properties

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Highlights

Synthesis and characterization of fluorophosphate glass containing luminescent CdS quantum dots. The CdS containing glasses are promising for photonic applications.

Resumo/Abstract

Quantum dots are an important class of semiconductor nanomaterials with interesting properties in photonics due to their size-controlled light emissions. Quantum dots emissions mainly occur by electronic transitions from the valence to conduction bands and the energy separation (E_{gap}) between these bands defines the emitted light wavelengths. Generally, quantum dots (QDs) are mainly obtained as colloidal materials, which limits their optoelectronic applications. In order to overcome this limitation, which can hamper their applications, different glass families are exploited as a solid matrix for hosting luminescent QDs. Fluorophosphate glasses (FPs) are an interesting matrix that arises from the combination of fluoride and phosphate precursors. Their properties, such as low characteristics temperatures, large thermal stability against crystallization, and wide transparency range from UV (300 nm) to near-infrared (4 μm) make them promising materials for optical and photonic applications.[1] However, even with such great characteristics, fluorophosphate glasses are still poorer explored as QDs hosts. In this sense, this work shows the study, synthesis, and characterization of fluorophosphate glasses containing CdS QDs. A new set of CdS-FP glasses were synthesized by the conventional melt-quenching method with the molar composition $\text{NaPO}_3\text{-ZnO-BaF}_2\text{-AlF}_3\text{-MgF}_2\text{:CdS}$. Then, the CdS QDs growth was carried out by controlled heat treatment above T_g , and the thermal properties were studied by DSC analysis. The structure of the oxyfluoride glasses as well as the network connectivity were studied by Raman, revealing the influence of the fluorine atoms in the glassy network due to the increase of Q^2 and Q^1 units. The optical properties were studied by UV-Vis which showed an increase in the absorbance of the sample with changes in heat treatment. Finally, the photoluminescence changed in function of heat treatment, suggesting the growth of CdS quantum dots, as observed by Transmission Electronic Microscopy (TEM) varying from 0.8 to 4.5 nm size. The obtained CdS containing fluorophosphate glasses showed promising properties for photonic and optoelectronic applications in the visible region.

References

[1] Doris Möncke and Hellmut Eckert. Review on the structural analysis of fluoride-phosphate and fluorophosphate glasses. In Journal of Non-Crystalline Solids: X. 2019.

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