

Suppression mechanism of radiation-induced darkening by Ce doping in Al/Yb/Ce-doped silica glasses : evidence from optical spectroscopy, EPR and XPS analyses.

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Yb³⁺/Al³⁺ co-doped silica glasses with different Ce₂O₃ contents were prepared using the sol-gel method combined with high-temperature sintering. Changes in refractive index, absorption, emission and fluorescence lifetime of these glasses caused by X-ray irradiation were recorded and analyzed systematically. It is found that co-doping with certain amount of Ce could greatly improve the radiation resistance without evident negative effects on the basic optical properties of the Yb³⁺ ions in the near-infrared region. The nature of the radiation-induced color centres and the mechanism by which Ce prevented the formation of these centres were studied using optical absorption, electron paramagnetic resonance (EPR), and X-ray photoelectron spectroscopy (XPS) methods. Direct evidence confirmed that trapped electron centres (Yb²⁺/Si-E'/Al-E') and trapped hole centres (Al-OHCs) were effectively inhibited by Ce doping, which was correlated to the coexistence of the redox couple Ce³⁺/Ce⁴⁺ in the glasses. These results are helpful to understand the micro-structural origin and the suppression mechanism by Ce co-doping of the photodarkening effect in Yb³⁺-doped silica fibers.

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