

Dy-Al-Ce codoped silica: a promising yellow laser glass with enhanced resistance to X-ray-induced photodarkening

Autorzy

Zhenghao Li
Xin Li
Yan Sun
Chongyun Shao
Wei Chen
Xin Wang
Chunlei Yu
Lili Hu
Małgorzata Guzik
Georges Boulon

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Streszczenie

To develop Dy doped silica glass with a higher irradiation resistance, which can be adapted to high power violet or blue LD pumped yellow laser fibers, the designed Dy-Al-Ce codoped silica glasses, $0.05\text{Dy}_2\text{O}_3\text{-}1.5\text{Al}_2\text{O}_3\text{-}x\text{Ce}_2\text{O}_3\text{-(}98.45\text{-}x\text{)SiO}_2$ ($x = 0, 0.05, 0.1, 0.25, 0.5$), were prepared by the sol-gel method. Their excitation spectra, emission spectra and emission decay curves associated with the yellow emission from $^4\text{F}_{9/2}$ to $^6\text{H}_{13/2}$ of Dy were determined before and after the X-ray irradiation of 1000 Gy. The relation between these spectra and Ce-codoping concentrations is discussed, including the sensitization from Ce to Dy, the reverse energy transfer from Dy to Ce, and especially the X-ray-induced photodarkening, which is detrimental to the 576 nm yellow emission of Dy. The centers that cause the photodarkening are analyzed by electron paramagnetic resonance and radiation induced absorption spectra. It is found that Ce can effectively suppress the Al-oxygen hole center induced by the X-ray across the entire concentration range of Ce-codoping, but a new photodarkening center is generated at higher concentrations of Ce-codoping. Finally, the optimized Ce-codoping concentration of ~ 0.1 mol% is used to achieve a promising yellow laser glass of Dy-Al-Ce codoped silica with enhanced irradiation resistance, resulting in its X-ray-induced photodarkening that is only 6% - 14% of that in the Ce-undoped.

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