193 nm excimer laser-induced color centers in $Yb^{3+}/Al^{3+}/P^{5+}$-doped silica glasses.

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Streszczenie

Yb^{3+}, Yb^{3+}/Al^{3+}, and Yb^{3+}/P^{5+} co-doped silica glasses, as well as pure silica, Al^{3+}, and P^{5+} single-doped silica glasses, were prepared using a sol–gel method combined with high-temperature sintering. The glasses were irradiated with a 193 nm ArF excimer laser for different durations. The species of the 193 nm laser-induced color centers were identified by radiation-induced absorption (RIA), in-situ photoluminescence (PL), and continuous-wave electron paramagnetic resonance (CW-EPR) spectroscopic techniques. To obtain the RIA and CW-EPR characteristics of each color center, the Gaussian decomposition of RIA and the line-shape simulation of the CW-EPR spectra were performed. The formation mechanism of the color centers was correlated with the glass microscopic structure, which was obtained by nuclear magnetic resonance (NMR) spectroscopy. The results show that the oxygen hole center and the Yb^{2+} ion pairs are primarily responsible for the radiation-induced darkening, and their formation is highly dependent on the charge balance between the Yb^{3+} ion and its ligand. This work provides insights into the underlying mechanism of pump light and/or external radiation-induced optical losses in Yb^{3+}-doped silica fibers.

Słowa kluczowe

Yb-doped silica glass, Color center, Photodarkening, Electron paramagnetic resonance

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