

Influence of Al^{3+} and P^{5+} ion contents on the valence state of Yb^{3+} ions and the dispersion effect of Al^{3+} and P^{5+} ions on Yb^{3+} ions in silica glass.

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Rok wydania

2014

Czasopismo

Journal of Materials
Chemistry C

Numer woluminu

2

Strony

4406-4414

DOI

10.1039/C3TC32576H

Kolekcja

Naukowa

Streszczenie

Three series of Yb^{3+} -doped silica glasses containing different amounts of Al_2O_3 and P_2O_5 were prepared successfully by using a sol-gel method. Absorption, excitation and fluorescence spectra of Yb^{2+} ions in these silica glasses as well as X-ray photoelectron spectra (XPS) of Yb4d were recorded and analysed systematically. It is found out that the addition of Al^{3+} or P^{5+} ions has great influence on the redox state of ytterbium ions. With increasing Al^{3+} ion contents in these silica glasses, more trivalent Yb^{3+} ions are reduced to divalent Yb^{2+} . In contrast, the increase of P^{5+} ion contents greatly promotes divalent Yb^{2+} ions to be oxidized to trivalent Yb^{3+} . The possible redox mechanisms have been explored and discussed in detail. The influence of Al^{3+} and P^{5+} ion contents on the near-infrared luminescence intensity of Yb^{3+} ions and cooperative luminescence of Yb^{3+} ion pairs was also discussed. Both the near-infrared luminescence intensity of Yb^{3+} ions and cooperative luminescence of Yb^{3+} ion pairs decrease gradually with increasing Al^{3+} and P^{5+} ion contents. The decrease of cooperative luminescence of Yb^{3+} ion pairs indicates a good dispersion effect of Al^{3+} and P^{5+} ions on Yb^{3+} ions in Yb^{3+} -doped silica glass. The results are useful for optimization of fabrication of the high quality Yb^{3+} -doped silica fiber by the composite design of Yb-Al-P co-doped silica glass.

Adres publiczny

<http://dx.doi.org/10.1039/C3TC32576H>

Strona internetowa wydawcy

<https://www.rsc.org/>

Język

Angielski

Typ publikacji

Artykuł

Plik został wygenerowany dnia 2026-10-09 00:46:22

Adres w repozytorium <https://old.chem.uni.wroc.pl/pl/repozytorium/p0RU1ry>.