

Spectroscopic investigations of Pr³⁺ ions in Na₂O-La₂O₃-ZnO-TeO₂ glasses.

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Rok wydania

2018

Czasopismo

Journal of Non-Crystalline
Solids

Numer woluminu

487

Strony

96-103

DOI

10.1016/j.jnoncrysol.2018.02.005

Kolekcja

Naukowa

Język

Angielski

Typ publikacji

Artykuł

Streszczenie

Tellurite glasses of the composition $x\text{Pr}_6\text{O}_{11}-(7-x)\text{La}_2\text{O}_3-3\text{Na}_2\text{O}-25\text{ZnO}-65\text{TeO}_2$ (where $x=0.005, 0.01, 0.1, 0.2, 0.5, 1.0$ and 2mol%) were obtained by the melt quenching technique. Absorption (300K), excitation (300K) and fluorescence spectra (at 77 and 300K) as well as fluorescence decay curves of the Pr³⁺-doped title glasses are presented and discussed. Basing on the Judd-Ofelt analysis, the phenomenological Judd-Ofelt parameters ($\Omega_2=2.13$, $\Omega_4=16.8$ and $\Omega_6=3.50\times 10^{-20}\text{cm}^2$), radiative transition probabilities (A_T), branching ratios (β), radiative lifetimes (τ_R) and emission cross-sections (σ_{em}) were calculated for the luminescence from $^3\text{P}_1$, $^3\text{P}_0$, $^1\text{D}_2$ and $^1\text{G}_4$ levels of the Pr³⁺ ion. The fluorescence from the $^1\text{G}_4$ level of the Pr³⁺ ion has been observed after excitation at 445nm in the $^3\text{P}_2$ state. The experimental lifetimes of the emission levels indicate strong concentration quenching. An analysis of non-radiative decay of the $^1\text{D}_2$ level indicate that energy migration via a diffusion limited relaxation and cross-relaxation processes are involved in the depopulation of this level. The spectroscopic results show that the investigated glasses are potentially candidates as at 1.3 μm and 1.45 μm laser host as well as reddish-orange to yellow tunable phosphor. Furthermore, a near-infrared downconversion process gives possibility of using of these materials as luminescent solar concentrators and near infrared lasers.

Słowa kluczowe

Pr³⁺, Tellurite glasses, luminescence, Quantum cutting, energy transfer, laser materials

Adres publiczny

<http://doi.org/10.1016/j.jnoncrysol.2018.02.005>

Strona internetowa wydawcy

<http://www.elsevier.com>

Plik został wygenerowany dnia 2026-04-28 00:58:58

Adres w repozytorium <https://old.chem.uni.wroc.pl/pl/repozytorium/GK-gMhi>.