Effect of Ge:Si ratio and charging energy on carriers trapping in $Y_2(Ge,Si)O_5$:Pr powders observed with thermoluminescence methods.

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Streszczenie

Oxyorthosilicates have long history in luminescent applications e.g. as phosphors, scintillators and in emerging technologies like luminescence thermometry. In this study we report detailed research on the thermoluminescent (TL) properties of $Y_2(Ge_x,Si_{1-x})O_5$:Pr. Despite regular TL measurements, T_{max}-T_{stop}, initial rise analysis, fading, decay of persistent luminescence, and dose effect are presented and analyzed. The possibility to deliberately manage the electron trap depths adjusting the Ge/Si ratio is explored. Glow curve of each composition consists of two main TL peaks. In the (Ge,Si) solid continuous distribution of trap energies is observed. Strong thermoluminescence is observed from all compositions after charging with X-ray radiation. Efficiency of charging traps with UV-C photons (fitting the $4f \rightarrow 5d_1$ transition energy) lowers systematically as the Si content increases. A growing coupling of the excited $5d_1$ level of Pr^{3+} and the host conduction band with the increase of Ge content is responsible for this effect. A scheme of the TL-related processes is presented using the vacuum referred binding energy (VRBE) approach for all the $Y_2(Ge_x,Si_{1-x})O_5$:Pr phosphors.

Słowa kluczowe

Thermoluminescence, Bandgap engineering, Oxyorthosilicates, Oxyorthogermanates, Pr 3+ luminescence

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