

Modeling luminescent properties of $\text{HfO}_2\text{:Eu}$ powders with Li, Ta, Nb, and V codopants.Autorzy

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Streszczenie

Monoclinic $\text{HfO}_2\text{:Eu,M}$ ($M = \text{Li, Ta, Nb, V}$) powders were prepared with the Pechini method. The M-dopants were added for charge compensation of Eu^{3+} positioned in $\text{Hf}^{(\text{IV})}$ site. This was hoped to enhance the host-to-activator energy transfer and consequently the overall efficiency of X-ray excited luminescence. Only in the case of codoping with Nb, the final phosphor did not contained any foreign phases indicating that $(\text{Eu}^{3+}, \text{Nb}^{(\text{V})})$ pairs easily dissolved in the host. In the $\text{HfO}_2\text{:Eu,V}$ composition, the phase purity was unsatisfying for higher concentrations. However, in the case of $\text{HfO}_2\text{:Eu,Ta}$ and $\text{HfO}_2\text{:Eu,Li}$ a foreign phase/phases could be easily detected even for quite low concentrations. The addition of Ta, Nb, or V allowed to create additional absorption/excitation bands located in UV around 225–250 nm, 240–300 nm, and 240–320 nm, respectively. However, only in the presence of Nb the red Eu^{3+} photoluminescence could be efficiently excited and strongly enhanced upon stimulation into this extrinsic excitation structure compared to other investigated compositions as well as to singly doped $\text{HfO}_2\text{:Eu}$ reported previously. While XRDs showed that $\text{HfO}_2\text{:Eu,Li}$ contained the highest fraction of a foreign phase, this composition was found to produce the most efficient red emission upon irradiation with X-rays. It reached about 30% of the commercial $\text{Gd}_2\text{O}_2\text{S:Eu}$ powder performance. This was achieved despite that a significant portion (roughly additional 30–35%) of the $\text{HfO}_2\text{:Eu,Li}$ radioluminescence was contained in a broad band covering the 400–600 nm range of wavelengths. Unfortunately, all the other codopants, Ta, Nb, and V, only suppressed the X-ray excited emission yield. Especially surprising was that the phase pure $\text{HfO}_2\text{Eu,Nb}$ powders, that presented the most efficient, truly bright photoluminescence, performed the least upon X-rays.

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