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Tunable color emitting of $\text{Ba}_{1-x-y}\text{SiO}_3:\text{xEu},\text{yBi}^{3+}$ phosphors with the self-reduction of Eu^{3+} ions calcined in air

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Abstract:

A series of $\text{Ba}_{1-x}\text{SiO}_3:\text{xEu}$ and $\text{Ba}_{0.92-y}\text{SiO}_3:0.08\text{Eu}, \text{yBi}^{3+}$ phosphors have been synthesized using one-step calcination of a precursor prepared by chemical co-precipitation. The self-reduction phenomenon of Eu^{3+} is observed and verified by photoluminescence (PL), excitation (PLE) spectra and X-ray photoelectron spectroscopy (XPS). Under 353 nm excitation, the $\text{Ba}_{1-x-y}\text{SiO}_3:\text{xEu},\text{yBi}^{3+}$ phosphors exhibit a broad band ranging from 390 nm to 560 nm with a peak centered at 499 nm originating from the $4f^65d \rightarrow 4f^7$ transition of Eu^{2+} ions and several narrow band emissions peaked at 464 nm, 537 nm, 581 nm, 590 nm, 615nm, 660nm and 705nm can be attributed to $^5\text{D}_2 \rightarrow ^7\text{F}_0$, $^5\text{D}_1 \rightarrow ^7\text{F}_1$, $^5\text{D}_0 \rightarrow ^7\text{F}_0$, $^5\text{D}_0 \rightarrow ^7\text{F}_1$, $^5\text{D}_0 \rightarrow ^7\text{F}_2$, $^5\text{D}_0 \rightarrow ^7\text{F}_3$ and $^5\text{D}_0 \rightarrow ^7\text{F}_4$ transition of Eu^{3+} , respectively. The self-reduction of $\text{Eu}^{3+} \rightarrow \text{Eu}^{2+}$ in $\text{BaSiO}_3:\text{Eu}$ calcined in air has been explained from the following aspects: the charge compensation mechanism and the structures of 3-D networks composed by SiO_4 tetrahedra, helpful for maintaining of the reduction ($\text{Eu}^{3+} \rightarrow \text{Eu}^{2+}$) at a high temperature. Co-doping Bi^{3+} ions can both enhance the emissions from Eu^{2+} and Eu^{3+} because the doped Bi^{3+} ions not only can make vacancy for Eu^{2+} but also can enhance the emitting for Eu^{3+} in BaSiO_3 . Moreover, when excited by 370 nm, the CIE chromaticity

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