Electronic Supplementary Information (ESI) for:

Synthesis, Photoluminescence and Structure of Novel Blue-emitting Eu^{2+}-doped $(SiC)_x$-$(AlN)_{1-x}$ Phosphors by Nitriding Combustion Reaction

Zhongqi Shi,*[a] Zhilei Wei,[a] Cheng He,*[a] Ruifeng Jing,[a] Hongjie Wang,[a] and Guanjun Qiao,[ab]

[a]. State Key Laboratory for Mechanical Behavior of Materials, School of Materials Science and Engineering, Xi'an Jiaotong University, Xi'an 710049, China

[b]. School of Materials Science and Engineering, Jiangsu University, Zhenjiang 212013, China

*Corresponding author. Tel.: +86 29 82667942; fax: +86 29 82663453.

E-mail address: zhongqishi@mail.xjtu.edu.cn (Z. Shi); hecheng@mail.xjtu.edu.cn (C. He)

Fig. S1 shows the typical temperature-time history for the combustion synthesis (CS) of $(SiC)_{0.06}$–$(AlN)_{0.94}$:0.0048Eu^{2+} phosphors with different Al/(AlN+SiC) mole ratio of 4:6, 5:5 and 6:4, respectively. Once the combustion reaction is triggered, the combustion temperature rapidly increases to the apex (>2000 °C), and then spontaneously decreases to room temperature. The combustion temperature gradually increases from 2037 to 2234 °C as the mole ratio increases. The whole combustion synthesis process lasts few minutes.

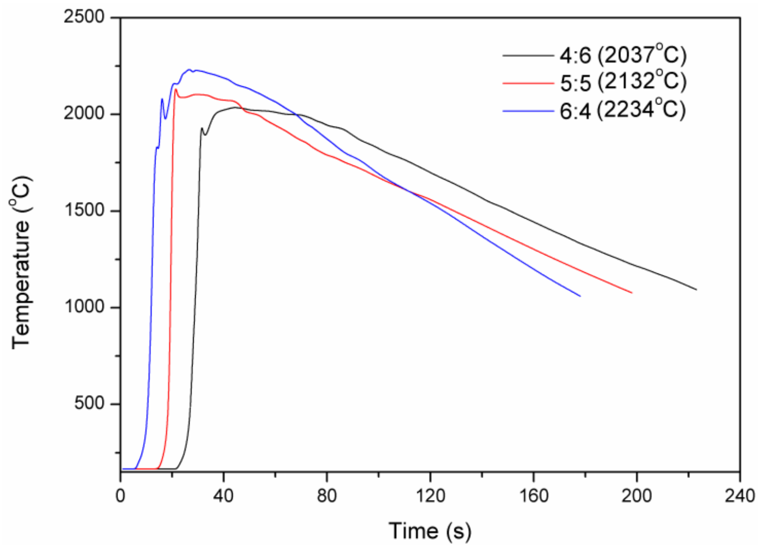

Fig. S1 Typical temperature-time history for the CS of $(SiC)_{0.06}$–$(AlN)_{0.94}$:0.0048Eu^{2+} phosphors with different Al/(AlN+SiC) mole ratio.

The XRD patterns of $(SiC)_{0.06}$–$(AlN)_{0.94}$:0.0048Eu^{2+} phosphors synthesized at different Al/(AlN+SiC) mole ratio are shown in Fig. S2. The powders synthesized at the mole ratio of 4:6 contain impurity phase of α-SiC, suggesting the conversion of β to α phase and incomplete solid-solution of SiC into AlN. The impurity phase disappears with the mole ratio increases to 5:5, and only 2H wurzite AlN-SiC ss phase is identified in the products. However, with the mole ratio further increases to 6:4, another impurity phase of Si appears. The formation of Si phase can be attributed to the displacement reaction between Al and SiO_2 from β-SiC according to the following reaction: $4Al_{(s)} + 3SiO_{2(s)} \rightarrow 3Si_{(s)} + 2Al_2O_{3(s)}$.

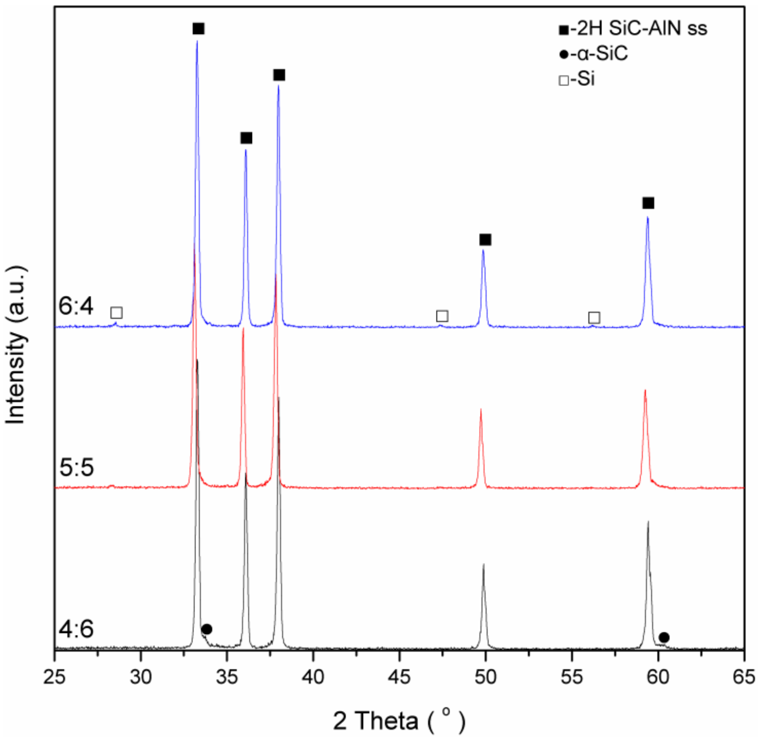

Fig. S2 XRD patterns of $(SiC)_{0.06}$–$(AlN)_{0.94}$:$0.0048Eu^{2+}$ phosphors synthesized with different Al/(AlN+SiC) mole ratio.

The excitation and emission spectra of $(SiC)_{0.06}$–$(AlN)_{0.94}$:$0.0048Eu^{2+}$ phosphors synthesized with different Al/(AlN+SiC) mole ratio are plotted in Fig. S3. Each phosphor shows similar excitation and emission spectra. The excitation spectra show a broad band in the range of 250–425 nm, which consists of three bands centered at 285 nm, 330 nm and 360 nm, respectively. These three excitation bands correspond to the crystal–field splitting of the 5d level of the Eu^{2+} ions. All the emission spectra exhibit a single and symmetric broadband centered at about 470 nm, which is attributed to $4f^65d$-$4f^7$ transitions of Eu^{2+}. No red emission is observed indicating that the Eu ions exist as Eu^{2+}.[1] Furthermore, the phosphors synthesized at Al/(AlN+SiC) mole ratio of 5:5 shows the strongest emission intensity due to its better crystallization and higher purity. Therefore, an Al/(AlN+SiC) mole ratio of 5:5 can be chosen to synthesize highly purity $(SiC)_x$–$(AlN)_{1-x}$:yEu^{2+} phosphors with high luminescence.

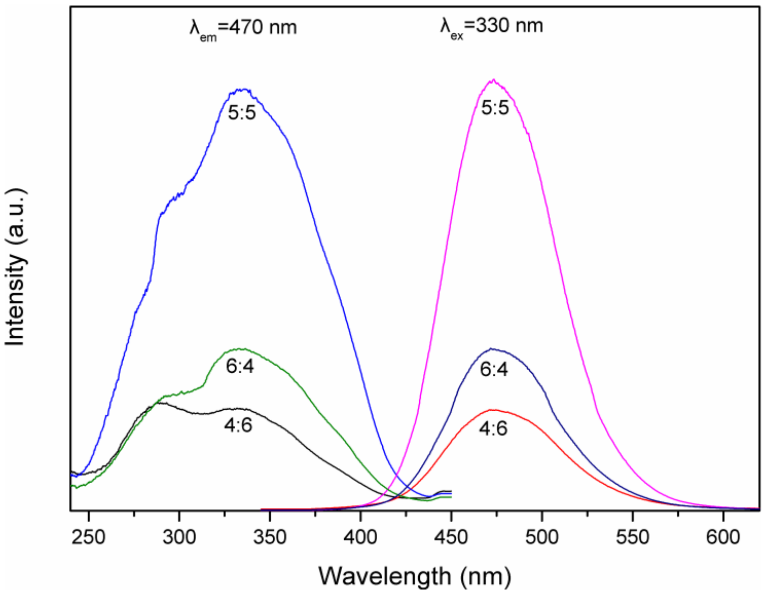

Fig. S3 The excitation (λ_{em}=470 nm) and emission spectra (λ_{ex}=330 nm) of $(SiC)_{0.06}$–$(AlN)_{0.94}$:$0.0048Eu^{2+}$ phosphors synthesized with different Al/(AlN+SiC) mole ratio.

The dependence of the highest relative emission intensity and peak position of $(SiC)_x$–$(AlN)_{1-x}$:yEu^{2+} phosphors on the SiC content (x value) and corresponding Eu^{2+} concentration (y value) was investigated, as shown in Fig. S4.

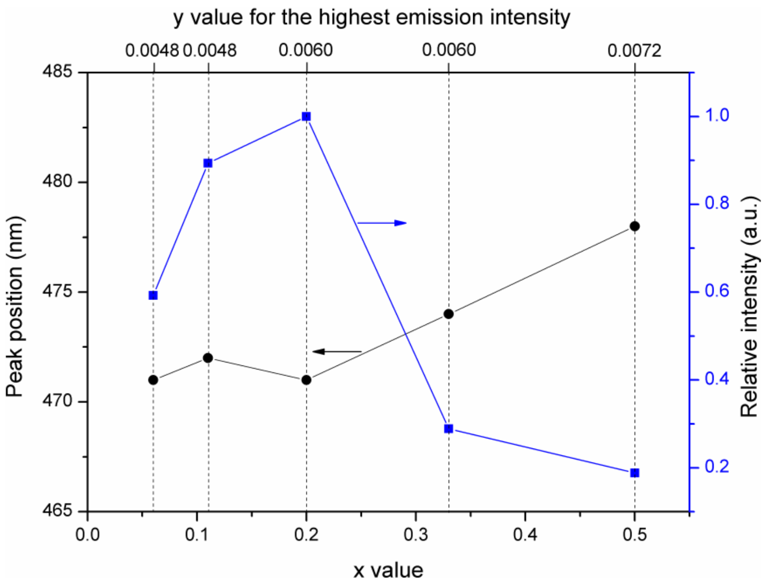

Fig. S4 The highest relative emission intensity and peak position of $(SiC)_x$–$(AlN)_{1-x}$:yEu^{2+} phosphors as a function of the SiC content (x value) and corresponding Eu^{2+} concentration (y value).

Reference:

(1) Inoue, K.; Hirosaki, N.; Xie, R. J.; Takeda, T. Highly efficient and thermally stable blue-emitting AlN:Eu^{2+} phosphor for ultraviolet white light-emitting diodes. *J. Phys. Chem. C* **2009**, 113, 9393–9397.