Supporting information

Journal of Materials Chemistry C

$Y_2Si_4N_6C:Ce^{3+}$ Carbidonitride Green-Yellow Phosphors: Novel Synthesis, Photoluminescence Properties, and Applications

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Figure S1: The selected area of SEM image and Y, Ce, Si, C elemental mapping of the carbonized precursor.

Figure S2: XRD patterns of $\text{Y}_{1.9}\text{Si}_4\text{N}_6\text{C}:0.1\text{Ce}^{3+}$ synthesized at (a) varying temperatures from 1500 °C to 1700 °C, (b) various heating time from 6 h to 8 h.

Figure S2a shows the XRD patterns of $\text{Y}_{1.9}\text{Si}_4\text{N}_6\text{C}:0.1\text{Ce}^{3+}$ samples synthesized at various temperatures ranging from 1500 °C to 1700 °C. At lower 1500 °C, two broad bands were detected indicating that the powders haven’t well crystallized and have no typical diffraction peaks of $\text{Y}_2\text{Si}_4\text{N}_6\text{C}$ phase (ICSD#155158). When calcination temperature increases to 1600 °C, XRD patterns of the obtained powders match well with ICSD standard card, testifying high phase purity of $\text{Y}_2\text{Si}_4\text{N}_6\text{C}$ phosphors prepared successfully. When further improved to 1700 °C, a little YN impurity phase (marked with red ♥) is detected, which may be due to the decomposition of $\text{Y}_2\text{Si}_4\text{N}_6\text{C}$ at high temperatures. Thus the synthesis temperature of 1600 °C is fixed as an optimal heat-treatment condition. Secondly, the calcination time is set by a variation of 6 h-8 h, seen in figure S2b. With calcination at 1600 °C for 6 h and 8 h, the well crystallized and pure $\text{Y}_2\text{Si}_4\text{N}_6\text{C}$ is obtained, while at longer 10 h, an impurity phase of YN is detected. Consequently, the optimized calcination time is set as the shorter 6 h.
Figure S3: XRD patterns of $Y_{2(1-x)}Si_4N_6C:2xCe^{3+}$ with varied $Ce^{3+}$ dopant concentration ($x=0.005-0.05$).

Figure S4: Emission spectra of $Y_{1.9}Si_4N_6C:0.1Ce^{3+}$ and commercial YAG:Ce$^{3+}$ phosphors as a reference.