Lithium ions doping triggered splendid quantum efficiency and thermal stability in Li$_2$SrSiO$_4$:xEu$^{2+}$ phosphors for optical thermometer and high luminous efficiency white-LED

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Table S1. Lattice parameters of the Li$_2$SrSiO$_4$:0.05Eu$^{2+}$/0.02Li$^+$ phosphors obtained from the Rietveld XRD refinement.

<table>
<thead>
<tr>
<th>Compounds</th>
<th>Li$_2$SrSiO$_4$:0.05Eu$^{2+}$/0.02Li$^+$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a = b$ (Å)</td>
<td>5.029233</td>
</tr>
<tr>
<td>$c$ (Å)</td>
<td>12.470967</td>
</tr>
<tr>
<td>$V$ (Å$^3$)</td>
<td>273.17</td>
</tr>
<tr>
<td>$\alpha = \beta$</td>
<td>90°</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>120°</td>
</tr>
<tr>
<td>Phase structure</td>
<td>Hexagonal phase</td>
</tr>
<tr>
<td>$Z$</td>
<td>3</td>
</tr>
<tr>
<td>$R_{wp}$</td>
<td>0.337</td>
</tr>
<tr>
<td>$R_p$</td>
<td>0.176</td>
</tr>
</tbody>
</table>
Table S2. CIE coordinates of the Li$_2$SrSiO$_4$:0.05Eu$^{2+}$ and Li$_2$SrSiO$_4$:0.05Eu$^{2+}$/0.01Li$^+$ phosphors at diverse excitation wavelengths.

<table>
<thead>
<tr>
<th>Compounds</th>
<th>$\lambda_{\text{ex}}$ (nm)</th>
<th>$x$</th>
<th>$y$</th>
<th>CCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li$_2$SrSiO$_4$:0.05Eu$^{2+}$</td>
<td>419</td>
<td>0.511</td>
<td>0.484</td>
<td>2599 K</td>
</tr>
<tr>
<td>Li$_2$SrSiO$_4$:0.05Eu$^{2+}$/0.01Li$^+$</td>
<td>419</td>
<td>0.515</td>
<td>0.481</td>
<td>2541 K</td>
</tr>
<tr>
<td>Li$_2$SrSiO$_4$:0.05Eu$^{2+}$</td>
<td>449</td>
<td>0.512</td>
<td>0.484</td>
<td>2589 K</td>
</tr>
<tr>
<td>Li$_2$SrSiO$_4$:0.05Eu$^{2+}$/0.01Li$^+$</td>
<td>449</td>
<td>0.515</td>
<td>0.483</td>
<td>2553 K</td>
</tr>
</tbody>
</table>

Figure S1. FE-SEM images of the (a) Li$_2$SrSiO$_4$:0.01Eu$^{2+}$, (b) Li$_2$SrSiO$_4$:0.05Eu$^{2+}$ and (c) Li$_2$SrSiO$_4$:0.05Eu$^{2+}$/0.02Li$^+$ phosphors. Particle size distribution of (d) Li$_2$SrSiO$_4$:0.01Eu$^{2+}$, (e) Li$_2$SrSiO$_4$:0.05Eu$^{2+}$ and (f) Li$_2$SrSiO$_4$:0.05Eu$^{2+}$/0.02Li$^+$ phosphors.
Figure S2. (a) Diffuse reflectance spectrum of the Li$_2$SrSiO$_4$:0.05Eu$^{2+}$ phosphors and Li$_2$SrSiO$_4$:0.05Eu$^{2+}$/0.02Li$^+$ phosphors. Calculation of the optical band gap of the (b) Li$_2$SrSiO$_4$:0.05Eu$^{2+}$ and (c) Li$_2$SrSiO$_4$:0.05Eu$^{2+}$/0.02Li$^+$ phosphor by using the Kubelka-Munk expressions.
Figure S3. Emission spectra of the Li$_2$SrSiO$_4$:0.05Eu$^{2+}$/0.02Li$^+$ phosphors as a function of temperature excited at (a) 419 nm and (b) 449 nm.
Figure S4. Emission spectra of the Li$_2$SrSiO$_4$:0.05Eu$^{2+}$ phosphors as a function of temperature excited at (a) 419 nm and (b) 449 nm. Temperature-dependent normalized emission intensities of the Li$_2$SrSiO$_4$:0.05Eu$^{2+}$ and Li$_2$SrSiO$_4$:0.05Eu$^{2+}$/0.02Li$^+$ phosphors excited at (c) 419 nm and (d) 449 nm.
Figure S5. (a) EL emission spectrum of the packaged blue chip-based white-LED device by utilizing the commercial YAG:Ce\textsuperscript{3+} yellow phosphors. (b) CIE coordinate diagram of the packaged blue chip-based white-LED device. Inset shows the images of the packaged white-LED device without and with injection current of 50 mA.