Supporting Information

Bi$^{3+}$ and Sm$^{3+}$ co-doped Cs$_2$AgInCl$_6$ perovskite microcrystals
with co-enhancement of fluorescence emission

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Table S1. Element content measured by ICP-MS. The molar concentration of Bi$^{3+}$ = 100%[Bi]/[In]; and the molar concentration of Sm$^{3+}$ = 100%[Sm]/[In].

<table>
<thead>
<tr>
<th>Sample Category</th>
<th>Precursor</th>
<th>Product (ICP-MS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sm$^{3+}$</td>
<td>Bi$^{3+}$ Sm$^{3+}$</td>
</tr>
<tr>
<td>Cs$_2$AgInCl$_6$: Sm</td>
<td>20% 0%</td>
<td>0.61% 0%</td>
</tr>
<tr>
<td>Cs$_2$AgBiCl$_6$: Bi</td>
<td>0% 20%</td>
<td>0% 18.9%</td>
</tr>
<tr>
<td>Cs$_2$AgInCl$_6$: Bi-Sm</td>
<td>20% 20%</td>
<td>0.21% 20.7%</td>
</tr>
</tbody>
</table>

Figure S1. The PXRD patterns of Cs$_2$AgInCl$_6$: Bi, Cs$_2$AgInCl$_6$: Sm and Cs$_2$AgBiCl$_6$: Bi-Sm compared to the simulated PXRD patterns without doping.
Figure S2. XPS spectrum of Cs$_2$AgInCl$_6$: Bi-Sm microcrystals.

Figure S3. SEM images of the undoped, Cs$_2$AgInCl$_6$: Sm and Cs$_2$AgInCl$_6$: Bi-Sm microcrystals.

Figure S4. Tauc plot of diffuse absorption measurements of Cs$_2$AgInCl$_6$, Cs$_2$AgInCl$_6$: Bi and Cs$_2$AgBiCl$_6$: Bi-Sm microcrystals.
Figure S5. PL comparison spectra of Cs$_2$AgInCl$_6$:0.2Bi-0.2Sm and Cs$_2$AgInCl$_6$:0.2Bi excited at 370 nm. Intuitively, the 567 nm and 600 nm peaks arise after doping Sm$^{3+}$ ions.

Figure S6. PL comparison spectra of Cs$_2$AgInCl$_6$:0.2Bi-0.2Sm and Cs$_2$AgInCl$_6$:0.2Sm excited at 370 nm. After co-doping Bi$^{3+}$, the emission peaks (567 nm and 600 nm) belonging to Sm$^{3+}$ can still be observed, although the significant increase of PL intensity. Figure S5-S6 confirm that the 567 nm and 600 nm PL peaks arise from electronic transition of Sm$^{3+}$ dopants.
Figure S7. Photographs of Bi/Sm MCs under visible light and UV light (365 nm) excitation.

Figure S8. PLQY of Cs$_2$AgInCl$_6$: Bi MCs with average 12.6%.
Figure S9. PLQY of Cs$_2$AgInCl$_6$: Bi-Sm MCs with average 13.4%.

Figure S10. EDS spectrum recorded from the Cs$_2$AgInCl$_6$: Bi-Sm sample shows the existence of Bi, Sm elemental signals.
Figure S11. PLE spectra of Cs$_2$AgInCl$_6$: Bi-Sm, Cs$_2$AgInCl$_6$: Bi and Cs$_2$AgInCl$_6$: Sm samples obtained by monitoring emitting wavelength at 600 nm, and normalized to $[0,100]$. 