Supplementary Information

**Fig S11**: X-ray powder diffraction pattern of the SrTmGa$_3$O$_7$ glass prepared by aerodynamic levitation coupled to laser heating device.
Fig SI 2: a) Differential Scanning Calorimetry (DSC) measurements of SrEuGa$_3$O$_7$, SrTbGa$_3$O$_7$ and SrYbGa$_3$O$_7$ glass compositions. $T_g$ and $T_x$ correspond respectively to glass transition and to crystallization temperatures. b) Crystallization ($T_x$ from onset point) and glass transition ($T_g$) temperatures determined from DSC analyses for the SrREGa$_3$O$_7$ compositions are presented versus the rare earth ionic radii.
**Fig S13:** In situ X-ray diffraction data of the nominal SrYbGa$_3$O$_7$ composition from 500°C up to 1500 °C (no phase modification occurred between room temperature and 500°C). The different colours correspond to the indexation of SrCO$_3$ (black), Yb$_2$O$_3$ (red), Ga$_2$O$_3$ (green), SrGa$_2$O$_4$ (pink), and Yb$_3$Ga$_5$O$_{12}$ (orange). From room temperature up to 800°C only the SrCO$_3$, Yb$_2$O$_3$ and Ga$_2$O$_3$ precursors are present, at 900°C SrCO$_3$ reacts with Ga$_2$O$_3$ to form SrGa$_2$O$_4$. At 1300°C Yb$_2$O$_3$ and Ga$_2$O$_3$ react to form the Yb$_3$Ga$_5$O$_{12}$ garnet material while the other crystalline phases melt before 1500°C.
Fig S14: In situ X-ray diffraction data of the nominal SrGdGa$_3$O$_7$ composition from 500°C up to 1500 °C (no phase modification occurred between room temperature and 500°C). The different colours correspond to the indexation of SrCO$_3$ (black), Gd$_2$O$_3$ (red), Ga$_2$O$_3$ (green), SrGa$_2$O$_4$ (pink), and SrGdGa$_3$O$_7$ (orange). From room temperature up to 800°C only the SrCO$_3$, Gd$_2$O$_3$ and Ga$_2$O$_3$ precursors are present. Then SrCO$_3$ reacts with Ga$_2$O$_3$ at 900°C to form SrGa$_2$O$_4$. At 1100°C SrGa$_2$O$_4$, Gd$_2$O$_3$ and Ga$_2$O$_3$ react to form the SrGdGa$_3$O$_7$ melilite, which is the only phase present at 1300°C. The SrGdGa$_3$O$_7$ melilite material eventually melts at around 1450°C.
Fig S15: [0-11]* electron diffraction pattern of SrTmGa$_3$O$_7$ showing extra reflections along the a* axis due to the 3x1x1 superstructure (red arrows). The indexations are provided in the usual 1x1x1 melilite cell, crystallizing in the tetragonal P-42$_1$m space group with $a = 7.92$ Å, $b = 7.92$ Å and $c = 5.22$ Å.

Fig S16: TEM image of a SrGdGa$_3$O$_7$ transparent ceramic. The photograph shows very thin grain boundaries and no residual glass or secondary phase between two grains.
Fig S17: Transmittance curves after thickness normalization at 1 mm of different Sr\textit{RE}Ga$_3$O$_7$ glasses (black) and ceramics (blue).
**Fig S18:** Colour coordinate diagram where the SrGdGa<sub>3</sub>O<sub>7</sub>:Dy<sup>3+</sup> is presented. WL represents the theoretical white light point at (x,y) = (0.33,0.33). The white line corresponds to the white light region limits.
**Fig S19:** Transmittance curves of SrGdGa$_3$O$_7$ (black) and SrGdGa$_3$O$_7$:1.5%Tb$^{3+}$:0.5%Eu$^{3+}$ (red) ceramics, for 1 mm thickness.

**Fig S10:** Emission spectra of the SrGd$_{0.98}$Ga$_3$O$_7$:1.5% Tb$^{3+}$,x Eu$^{3+}$ ceramics excited at 312 ± 4 nm. These spectra were used to determinate the quantum efficiency of the material.