Supporting Information

1. Chemicals

Gd(OAc)$_3$·4 H$_2$O (99.9 %) and Eu(OAc)$_3$·H$_2$O (99.9 %) were purchased from ABCR. The ionic liquids [choline][H$_2$PO$_4$] (98 %) and [choline][BF$_4$] (99 %) were purchased from Iolitec. The solvents were purchased from Fisher Scientific (dichloromethane, 99.9%), Sigma-Aldrich (Ethanol, abs.) and J. T. Baker (ethylene glycole, 99%). All chemicals were used without further purification.

2. Electron Microscopy (TEM and EDX)

SI-Figure 1. TEM micrographs of the as-prepared, surface modified material.

SI-Figure 2. EDX and particle size distribution of the as-prepared, surface modified material.

SI-Figure 3. TEM micrograph and corresponding EDX of the as-prepared material illustrating the core-shell structure.
SI-Figure 4. TEM micrograph and EDX of the material after heat treatment at 850 °C.

SI-Figure 5. TEM micrographs of pure, non-coated GdF₃:Eu³⁺.

SI-Figure 6. EDX and particle size analysis of pure, non-coated GdF₃:Eu³⁺.
**SI-Figure 7.** Decay profiles of the as-prepared phosphate coated GdF$_3$:Eu$^{3+}$ particles and after heat treatment at 850 °C.

**SI-Figure 8.** Powder X-ray diffraction patterns of the as-prepared material as well as after heat treatment. Theoretical patterns of GdF$_3$ and GdPO$_4$ simulated from single crystal X-ray data together with the database pattern of GdOF as a potential contamination.