Supplementary Material (ESI) for Journal of Materials Chemistry

SUPPLEMENTARY INFORMATION:

Efficient Oxide Phosphors for Light Upconversion; Green Emission from Yb^{3+} and Ho^{3+} Co-Doped Ln_2BaZnO_5 (Ln=Y, Gd)

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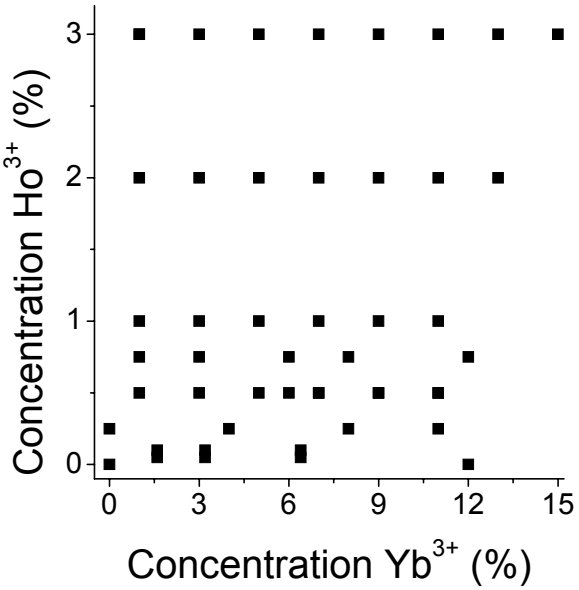

Figure S1: Yb^{3+} and Ho^{3+} concentrations of the Y_2BaZnO_5:Yb^{3+},Ho^{3+} samples for which upconversion efficiencies were measured (see Figure 4).

$\lambda_{excitation}$	900 nm	977 nm	455 nm	977 nm	455 nm	977 nm	455 nm
$\lambda_{emission}$	1040 nm	545 nm	545 nm	760 nm	760 nm	1200 nm	1200 nm
T = 80 K	165 µs	208 µs	180 µs	223 µs	172 µs	1730 µs	1630 µs
T = 107 K	178 µs	185 µs	128 µs	183 µs	128 µs	1780 µs	1690 µs
T = 133 K	195 µs	180 µs	102 µs	180 µs	102 µs	1840 µs	1750 µs
T = 185 K	215 µs	219 µs	84 µs	201 µs	72 µs	1800 µs	1730 µs
T = 239 K	275 µs	236 µs	57 µs	224 µs	52 µs	1680 µs	1676 µs
T = 293 K	344 µs	280 µs	46 µs	291 µs	47 µs	1520 µs	1510 µs
T = 348 K	481 µs	298 µs	43 µs	296 µs	43 µs	1240 µs	1280 µs
T = 403 K	522 µs	284 µs	38 µs	287 µs	40 µs	996 µs	1050 µs
T = 458 K	517 µs	247 µs	37 µs	242 µs	37 µs	811 µs	808 µs
T = 513 K	496 µs	219 µs	33 µs	219 µs	33 µs	654 µs	639 µs
T = 573 K	438 µs	214 µs	28 µs	195 µs	29 µs	544 µs	469 µs

Table S1: Temperature dependence of lifetimes corresponding to the 1040 nm emission under pulsed 900 nm excitation, the 545 nm and 760 nm emissions under pulsed 977 nm and 455 nm excitations, and the 1200 nm emission under pulsed 977 nm and 455 nm excitations in $Y_2BaZnO_5:Yb^{3+}$(7 %),Ho^{3+}(0.5 %). Errors in the reported values are typically of the order 5 %.

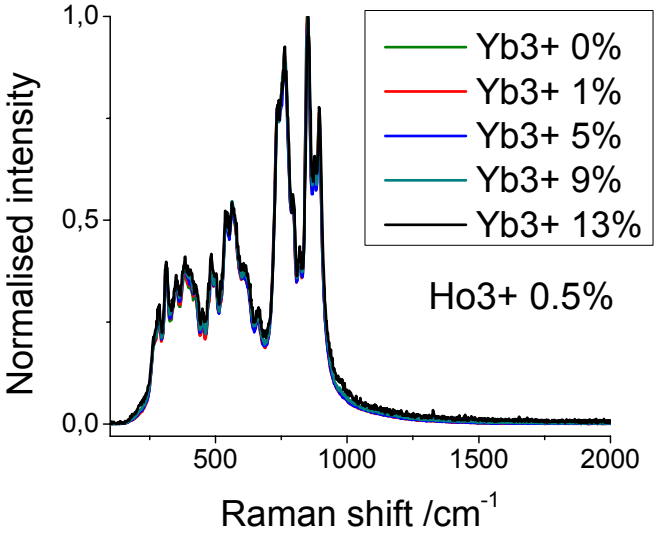

Figure S2: Raman spectra of $Y_2BaZnO_5:Yb^{3+}$(x %),Ho^{3+}(0.5 %) samples (x = 0,1,5,9,13) under 633 nm excitation at room temperature.

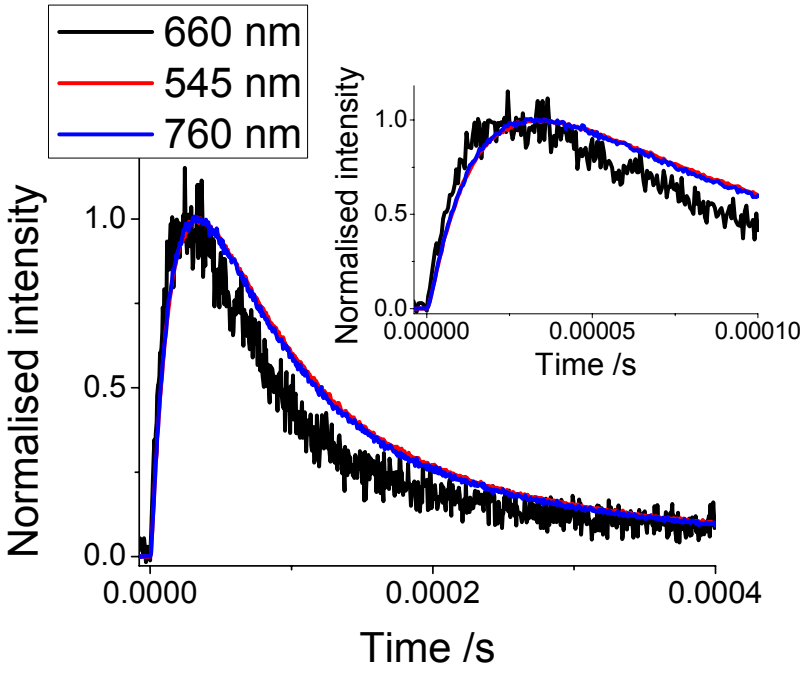

Figure S3: Normalized transients corresponding to the emissions at 545 nm, 760 nm and 660 nm under 977 nm excitation in Y_2BaZnO_5:Yb^{3+}(11 %),Ho^{3+}(0.5 %) at room temperature. Note that the emission at 660 nm was very weak, hence the poor signal to noise ratio. The inset represents a zoom of the transients at short times.