Electronic Supplementary Material (ESI) for Dalton Transactions.

Supporting Information

Large enhancement of upconversion luminescence by dye/Nd3+ sensitization of quenching-shield sandwich structural upconversion nanocrystal under 808nm excitation

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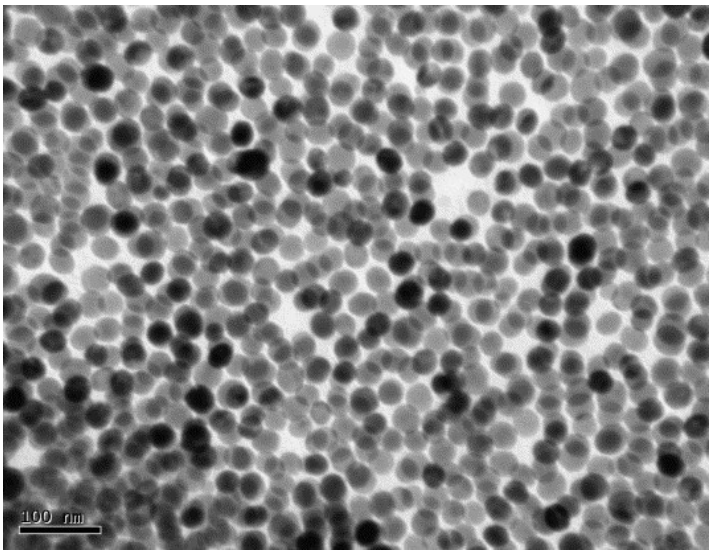
a)



b)

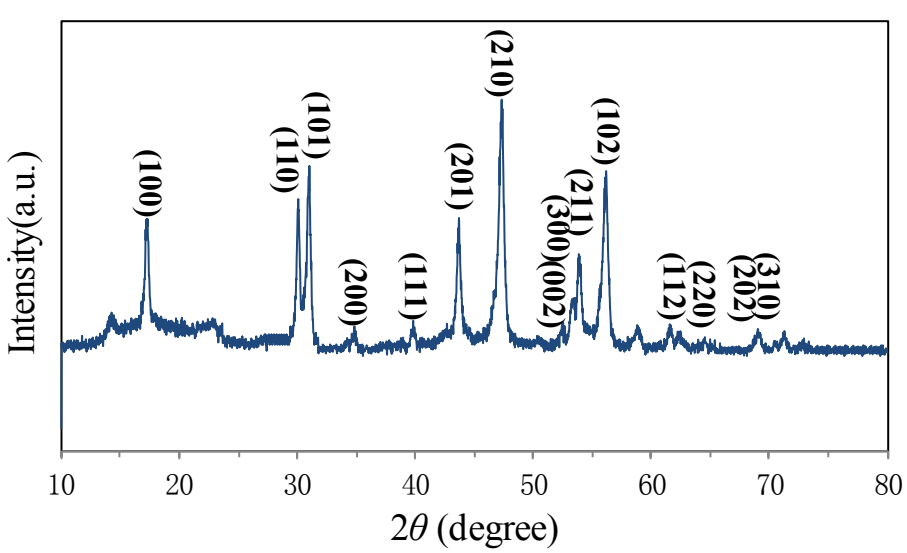


Figure S1. a) TEM images of the as-preparedNaLuF$_4$:Gd,Yb,Tm(24/20/0.5%)@NaLuF$_4$:Gd,Yb(24/10%)@NaLuF$_4$:Yb(10%) nanocrystals; b)Experimental powder XRD patterns of theNaLuF$_4$:Gd,Yb,Tm(24/20/0.5%)@NaLuF$_4$:Gd,Yb(24/10%)@NaLuF$_4$:Yb(10%) nanocrystals.

Synthesis of IR-820 dye

^{1}H-NMR (500 MHz, d_6-DMSO): δ =7.90 (d, J = 8.6 Hz, 2H), 7.86 (d, J = 14.0 Hz, 2H), 7.52 (dd, J = 11.9, 7.9 Hz, 4H), 7.44 (d, J = 8.0 Hz, 2H), 7.39 (t, J = 7.7 Hz, 2H), 7.22 (t, J = 7.7 Hz, 2H), 6.23 (d, J = 14.0 Hz, 2H), 4.16 (d, J = 7.5 Hz, 4H), 3.06 (s, 4H), 2.56-2.53 (m, 2H), 1.90-1.64 (m, 10H), 1.39 (s, 12H).

MS: calculated for $C_{44}H_{49}N_2O_8S_3$: 829.26; found: 829.31.

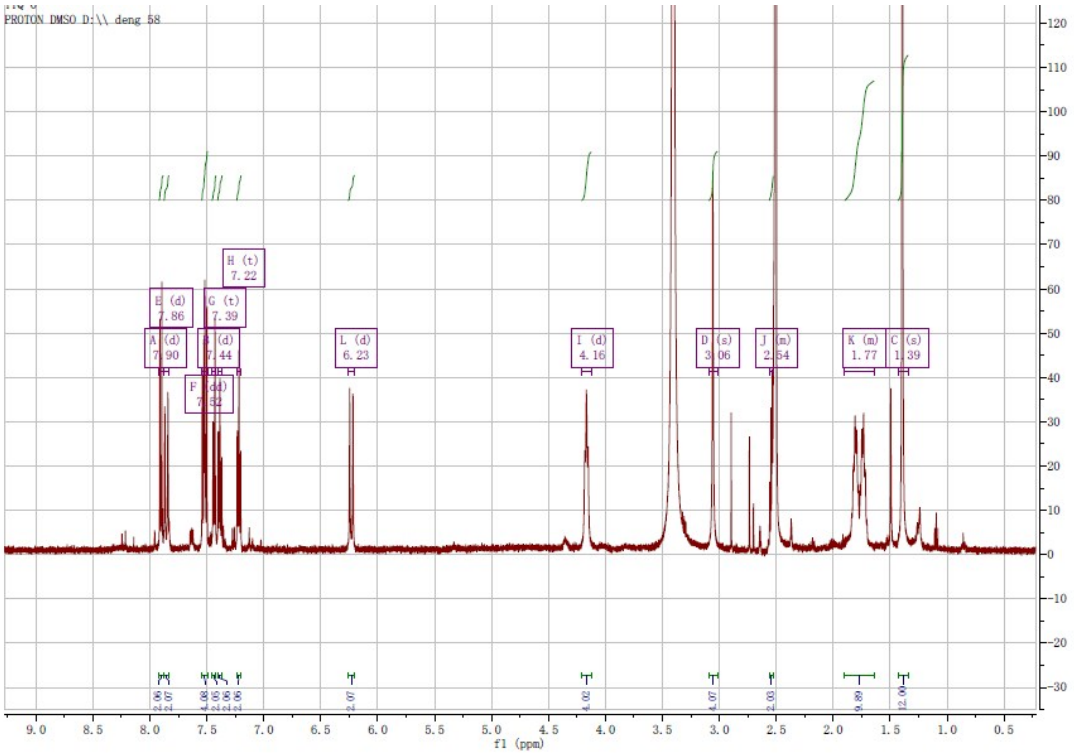


Figure S2. ^{1}H-NMR (500 MHz, d_6-DMSO) spectrum of IR-820.

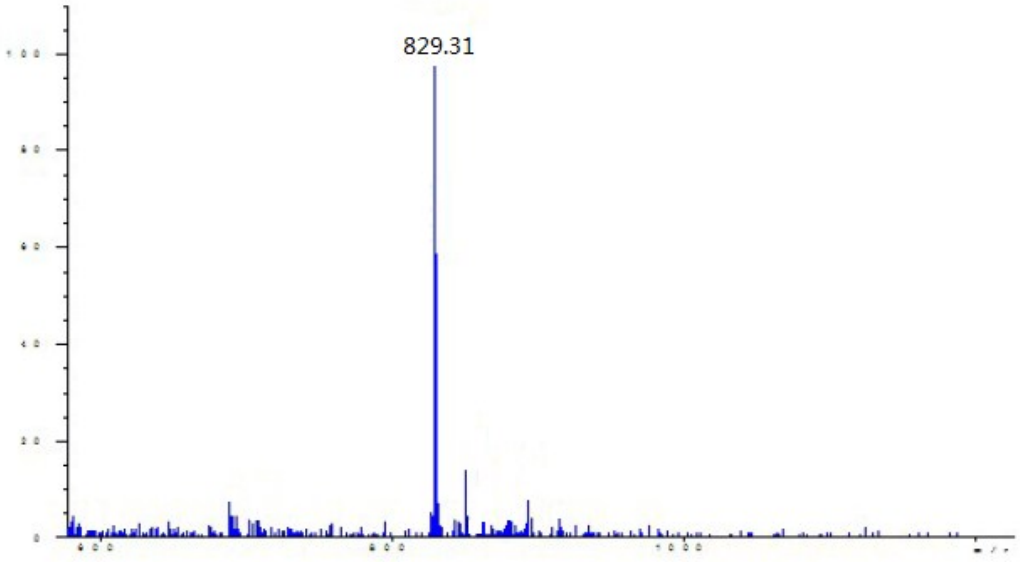


Figure S3. ESI Mass spectrum of IR-820

Figure S4. Photographic images**:** a) IR-820 dye; b) OA-coated nanoparticles; c) IR-820 functionalized nanoparticles.

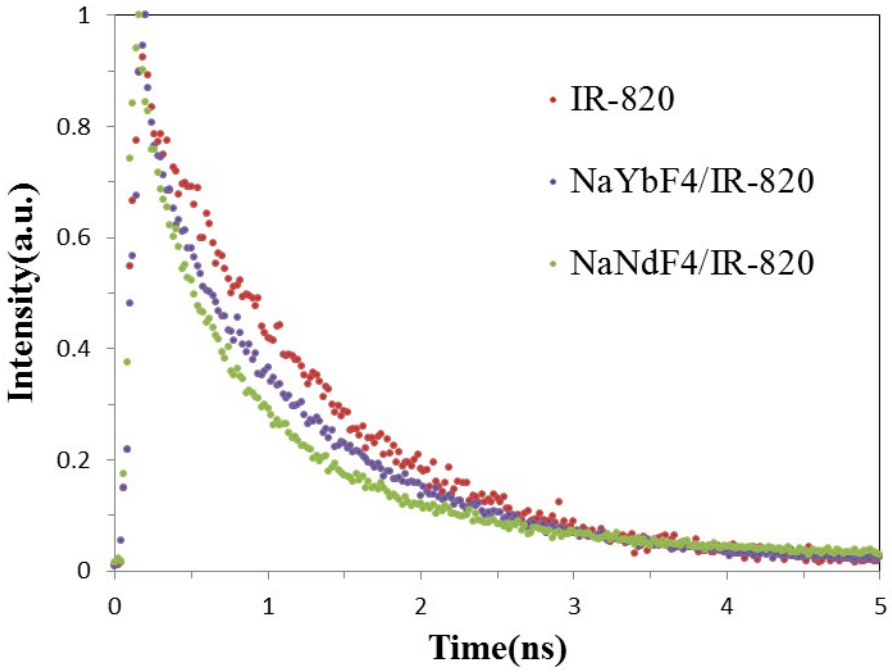


Figure S5. Fluorescence decays of the IR-820 dye from the pure dye, the IR-820 dye-sensitized $NaYbF_4$ nanoparticles as well as the IR-820 dye-sensitized $NaNdF_4$ nanoparticles.

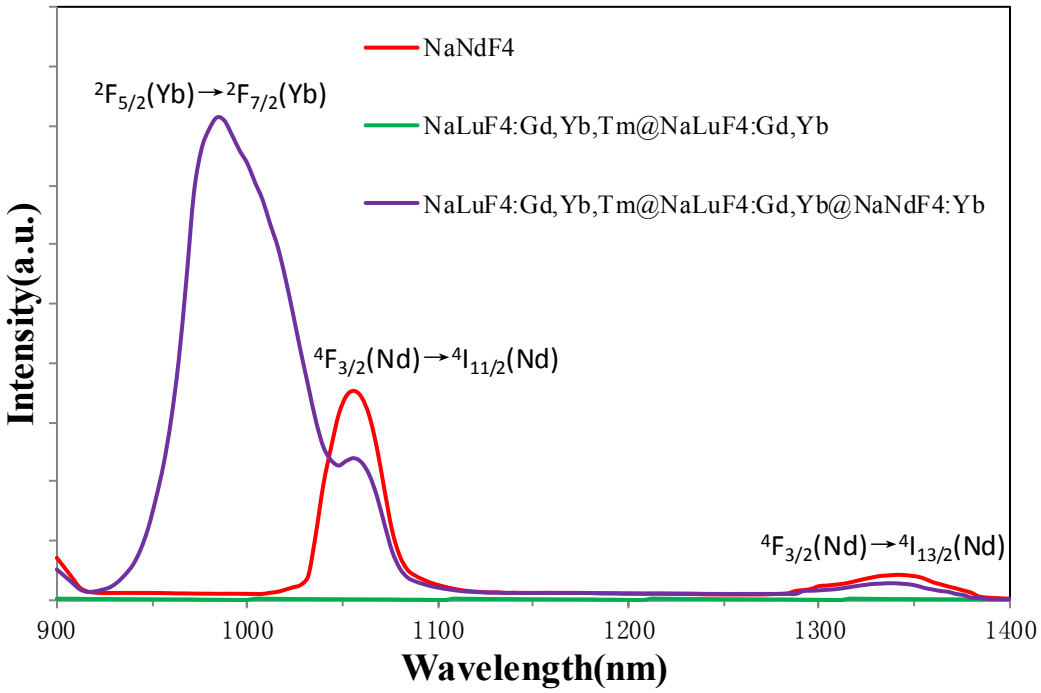


Figure S6. A comparison of downconversion luminescence (DCL) from $NaNdF_4$, $NaLuF_4$:Gd,Yb,Tm@$NaLuF_4$:Gd,Yb, and $NaLuF_4$:Gd,Yb,Tm@$NaLuF_4$:Gd,Yb @$NaNdF_4$:Yb nanoparticles (hexane dispersion, excited at 808 nm).