

Supplementary information file

Highly enhanced visible light water splitting of CdS by green to blue upconversion

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1. Determination of Triplet Triplet Annihilation up conversion (TTA-UC) Emission Quantum Efficiency

The upconversion luminescence quantum yield (Φ_{UC}) of a fluorophore is determined relative to a reference compound of known Φ_{UC} . If the same excitation wavelength, gain and slit bandwidths are applied for the two samples then the Φ_{UC} is calculated.

$$\Phi_{UC} = \Phi_{UCref} \frac{\mu^2}{\mu_{ref}^2} \frac{I}{I_{ref}} \frac{A_{ref}}{A}$$

Where Φ_{UCref} is the quantum yield of the reference compound, μ is the refractive index of the solvents. The reflective index of water and tetrahydrofuran (THF) are 1.33 and 1.41 at 293 K respectively. I is the integrated fluorescence intensity and A is the absorbance at the excitation wavelength. Two photons are required to generate one upconverted photon. Therefore, the maximum theoretical quantum yield is 0.50. It should be noted that UC quantum yield of Pt(OEP)/DPA is known to be strongly dependent on the experimental conditions, such as concentration of chromophore, solvent, and excitation power, even if the employed donor and acceptor are identical.

2. Electrochemical Measurements

2.1. Reversible Hydrogen Electrode (RHE) conversion

A saturated silver chloride electrode was used as the reference electrode in all measurements. The measured potentials versus Ag/AgCl reference electrode were converted to the reversible hydrogen electrode (RHE) scale using the Nernst equation:

$$E_{RHE} = E_{Ag/AgCl} + 0.241 \text{ V} + (0.0591 \times \text{pH at } 25^\circ\text{C})$$

2.2 Photon conversion efficiency

The following expression is used to calculate the photo conversion efficiency for each photoelectrode as,

$$\eta = I(1.23 - V)/J_{light}$$

Here, V is the applied bias vs RHE, I is the photocurrent density at the measured bias, and J_{light} is the irradiance intensity of 100 mW cm⁻².

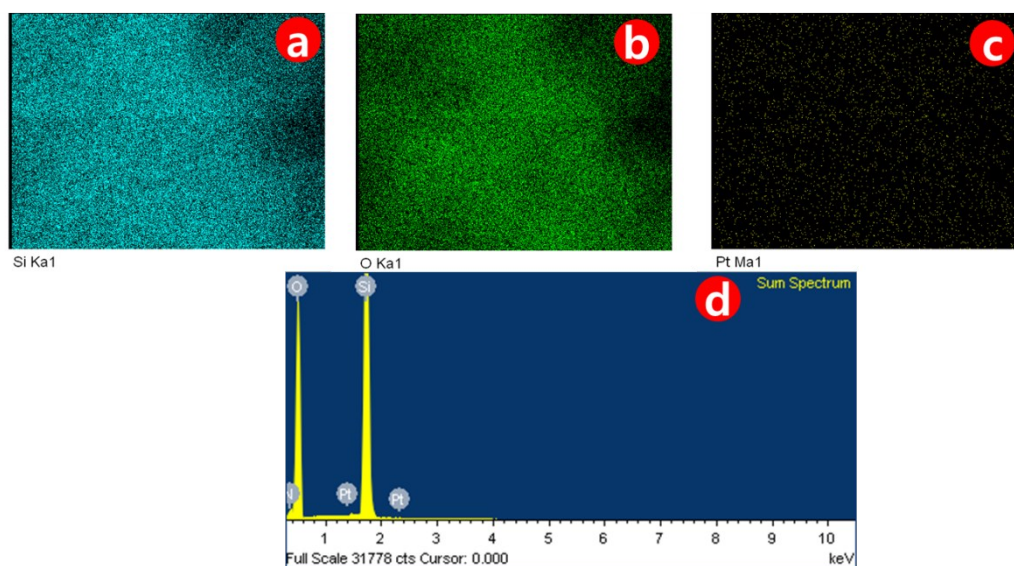


Fig. S1 (a-c) Elemental mapping and (d) EDS analysis of silica nanocapsules (SNC's)

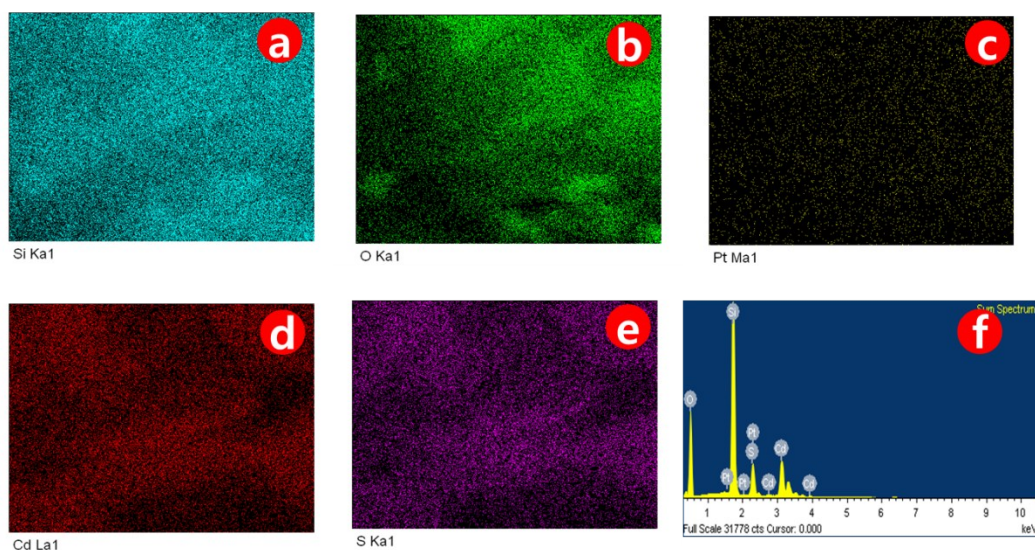


Fig. S2 (a-e) Elemental mapping and (f) EDS analysis of CdS attached silica nanocapsules

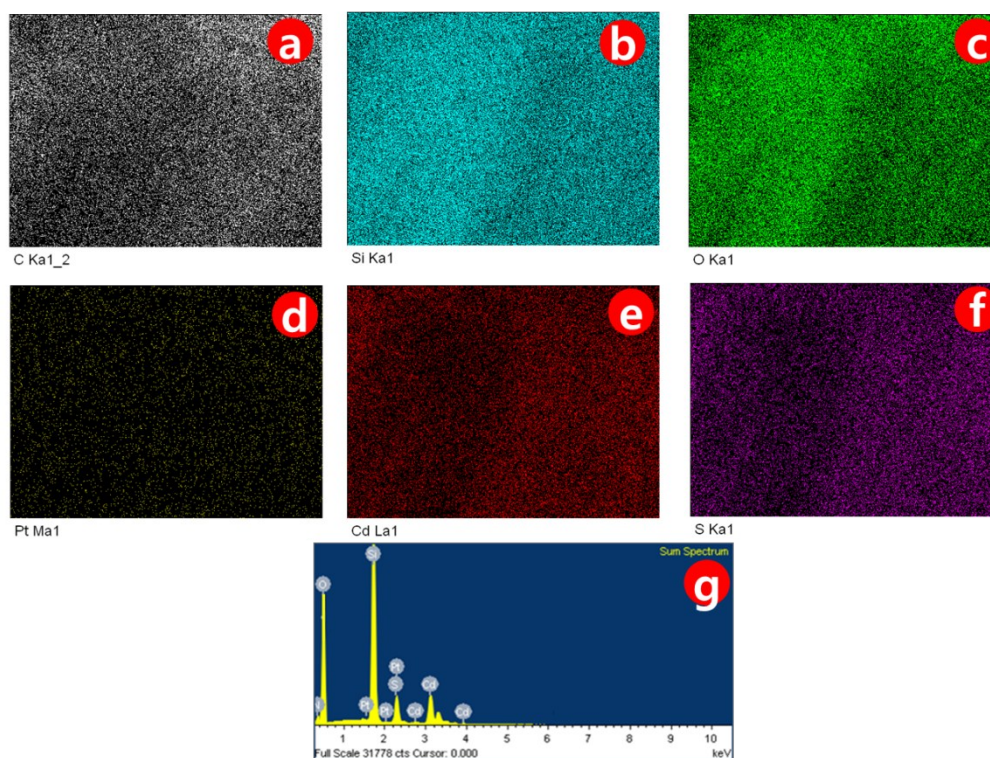


Fig. S3 (a-f) Elemental mapping and (g) EDS analysis of 2 wt% rGO/CdS attached silica nanocapsules

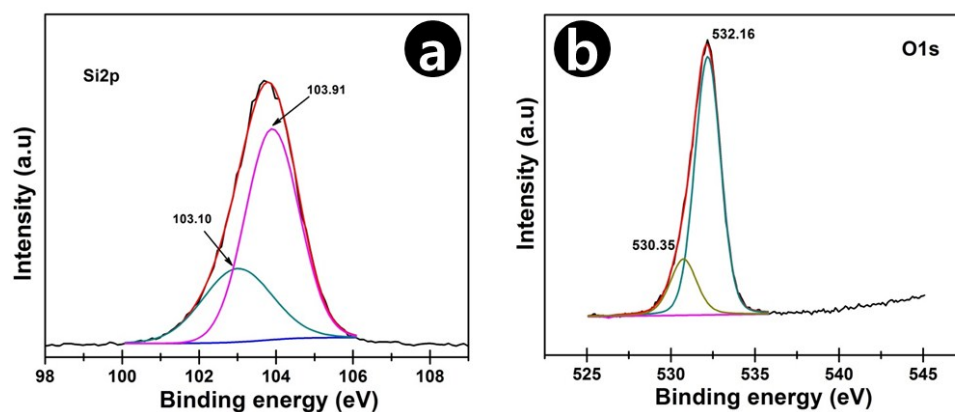


Fig. S4 (a) Si2p and (b) O1s core-level XPS spectra of silica nanocapsules

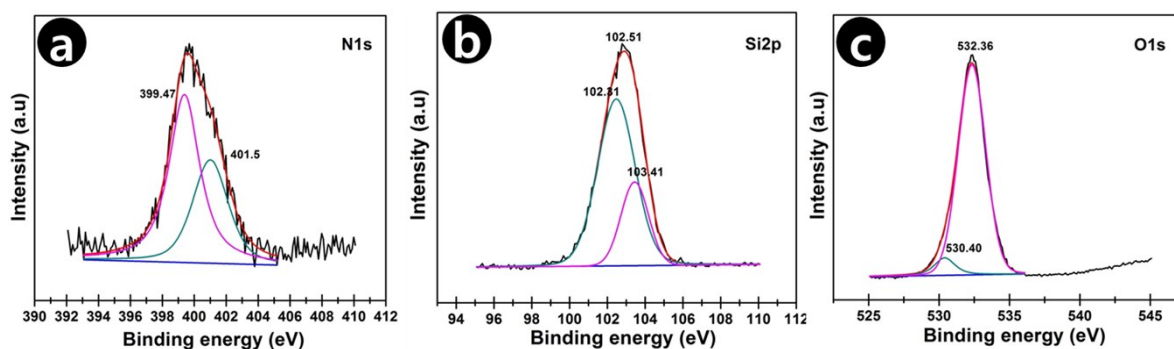


Fig. S5 (a) N1s (b) Si2p and (b) O1s core-level XPS spectra of functionalized silica nanocapsules

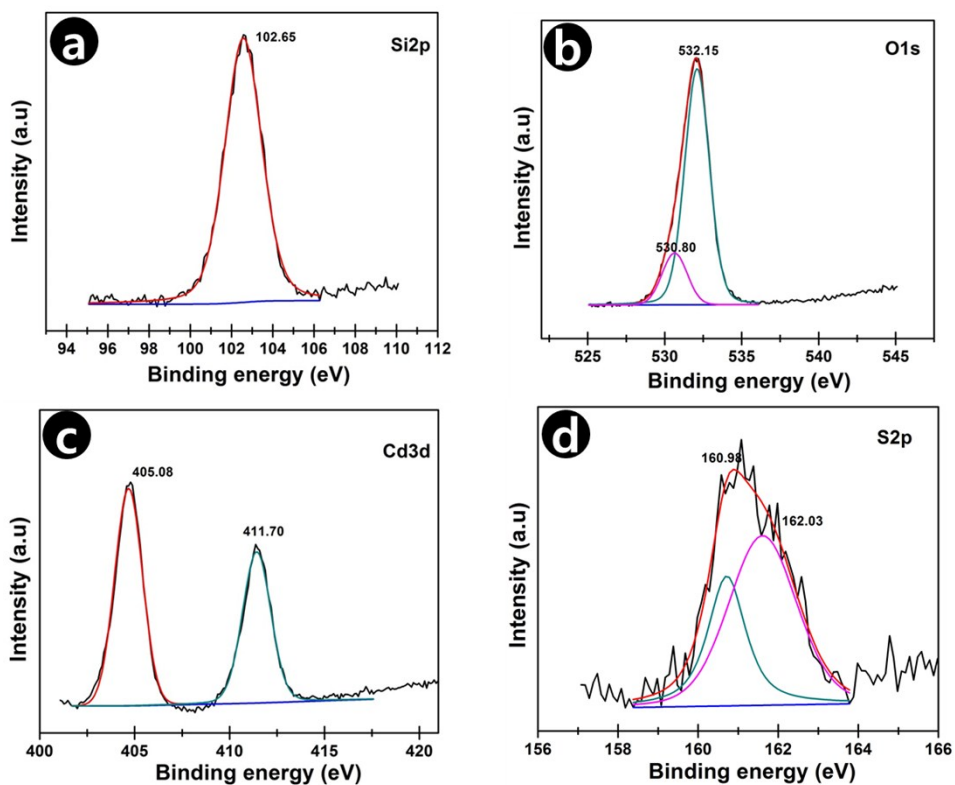


Fig. S6 (a) Si2p (b) O1s (c) Cd3d and (d) S2p core-level XPS spectra of CdS attached silica nanocapsules

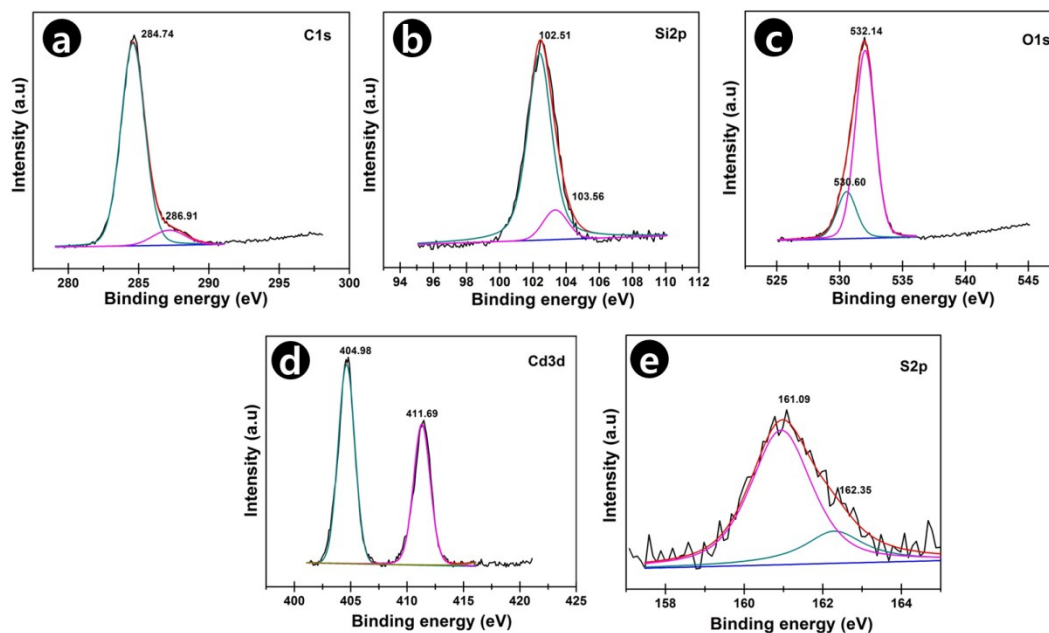


Fig. S7 (a) C1s (b) Si2p (c) O1s (d) Cd3d and (e) S2p core-level XPS spectra of 2 wt% rGO/CdS attached silica nanocapsule

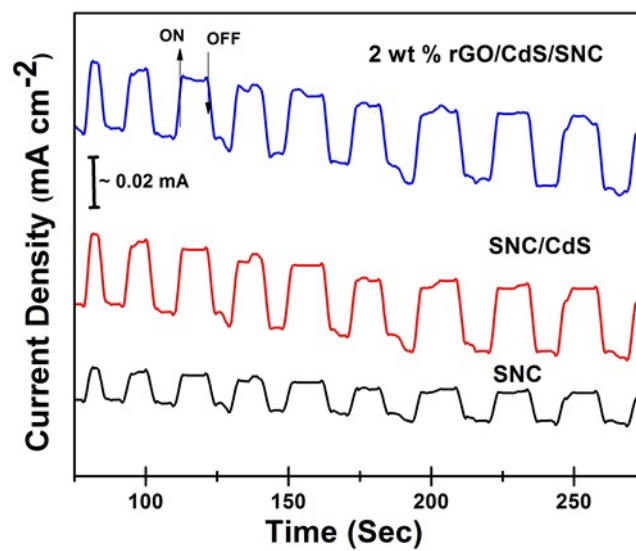


Fig. S8 The Photo-response curve of SNC, SNC/CdS and 2 wt % rGO/CdS/SNC at 1.2 V vs RHE

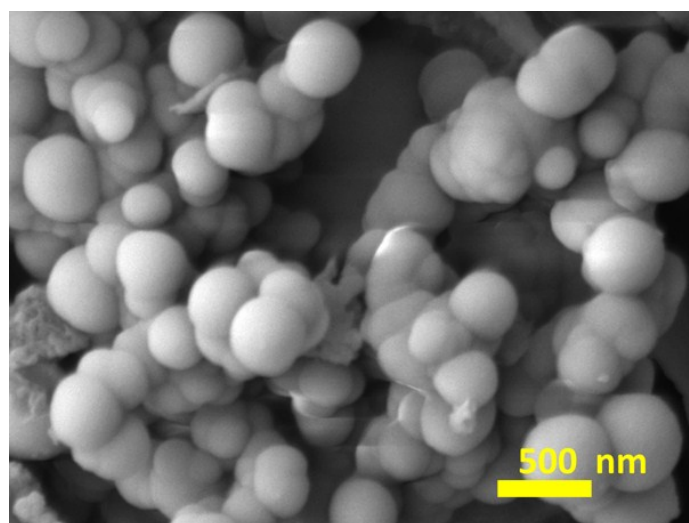


Fig. S9 FE-SEM image of functionalized silica nanocapsules

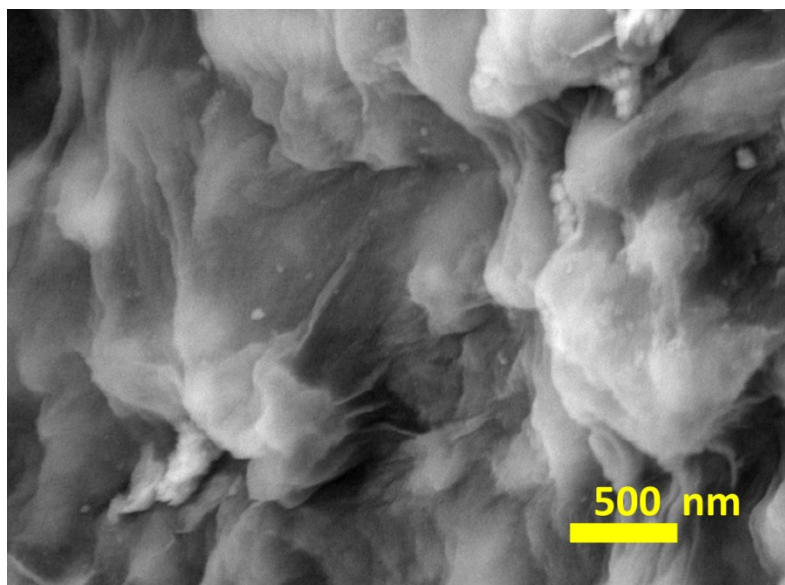


Fig. S10 FE-SEM image of 3 wt% rGO/CdS/SNC's

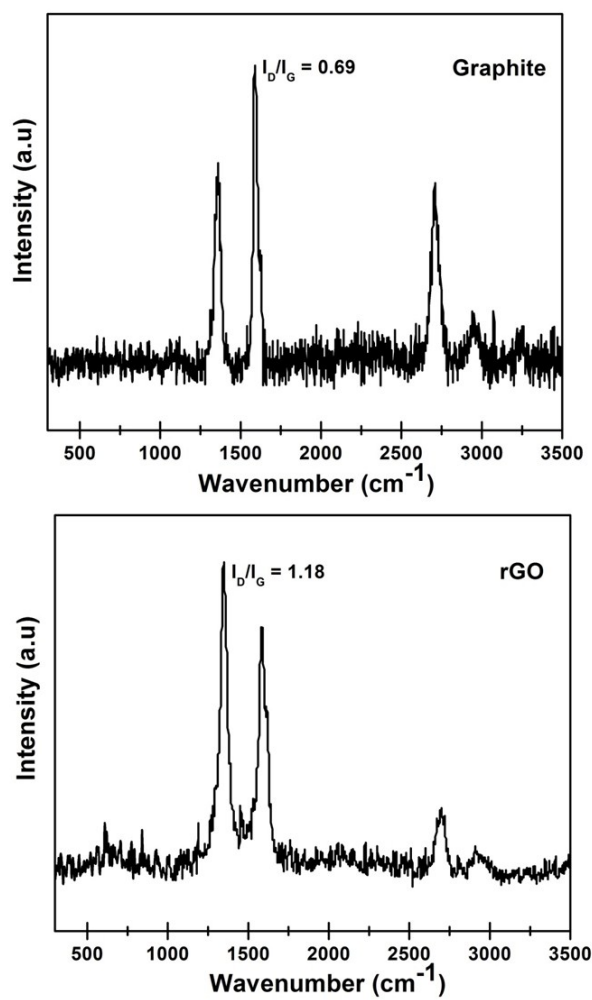


Fig. S11 Raman spectra of graphite and reduced graphene oxide (rGO)

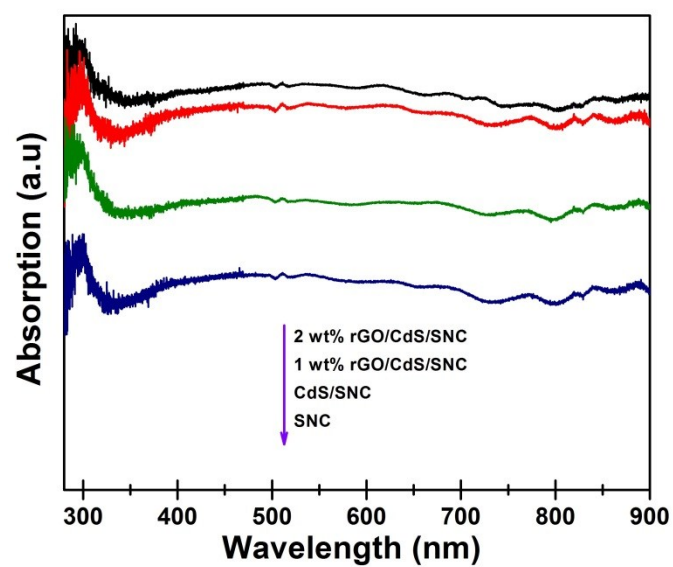


Fig. S12 UV-Vis absorption spectra of the prepared nanocapsules