Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics

Supporting Information

Photoselective Excited State Dynamics in ZnO-Au Nanocomposites and their Implications in Photocatalysis and Dye-Sensitized Solar Cells

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1. TEM images and particle size distributions of bare ZnO NPs and ZnO-Au NCs:

From TEM image (Figure S1, S2 and S3) it was found that bare ZnO NPs and Au NPs are spherical with average diameter ~6 nm and ~8 nm, respectively.

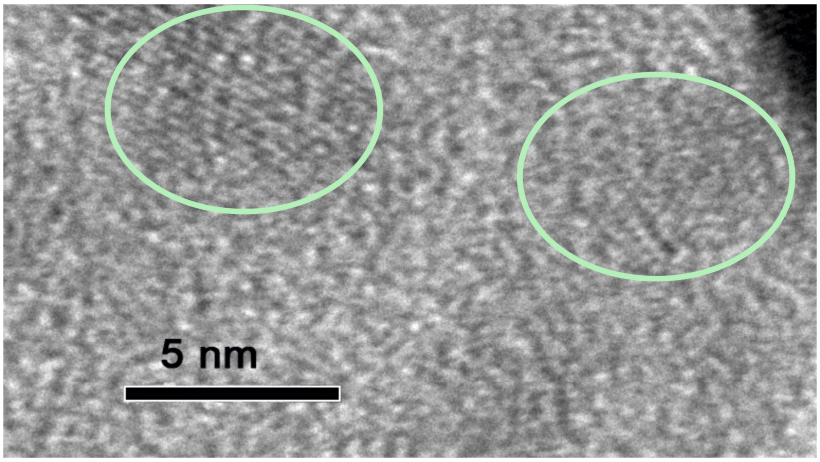

Figure S1: High-resolution TEM (HRTEM) image of bare ZnO NPs.

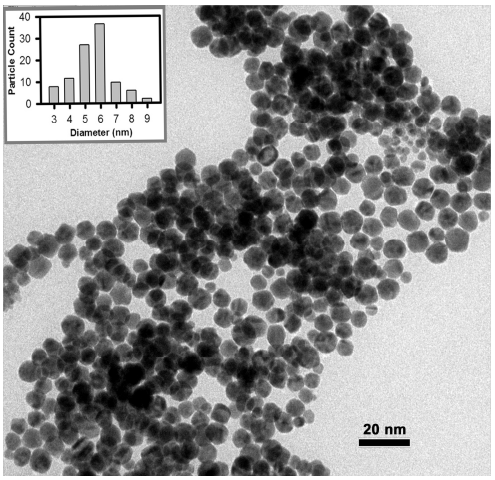

Figure S2: Low-Resolution TEM (LRTEM) image of bare ZnO NPs (inset shows particle size distribution of ZnO NPs).

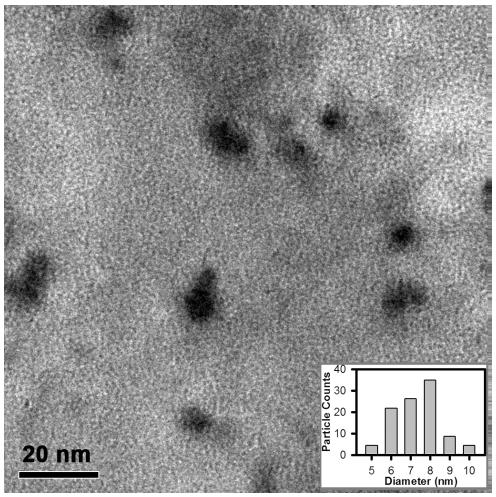

Figure S3: Low-Resolution TEM (LRTEM) image of ZnO-Au NCs (inset shows particle size distribution of Au NPs attached to ZnO NPs).

2. Analysis of ZnO-Au NCs by EDAX:

After the synthesis of ZnO-Au NCs, the Zn:Au weight ratio was calculated by using using a field emission-type scanning electron microscope (FEI-SEM; Quanta 200). From EDAX analysis it was found to be 1.3:1. The results are as follows:

Element	Avg. Weight %
O	52.83
Zn	20.32
Au	26.85

3. Energy transfer from ZnO NPs to Au NPs upon excitation above the band-edge: picosecond-resolved study

Details of the time-resolved spectroscopic data have been measured (**Figure S2**) with a time correlated single photon counting (TCSPC) setup from Edinburgh Instruments, in which the sample was excited by the third harmonic laser beam (300 nm) of the 900 nm (0.5 nJ per pulse) using a mode-locked Ti-sapphire laser with an 80 MHz repetition rate (Tsunami, Spectra Physics), pumped by a 10 W Millennia (Spectra Physics) followed by a

pulse-peaker (rate 8MHz) and a third harmonic generator (Spectra-Physics, model 3980). The third harmonic beam was used for excitation of the sample inside the TCSPC instrument (instrument response function, IRF=50 ps) and the second harmonic beam was collected as for the start pulse.

Upon band-edge excitation the energy transfer efficiency (E) is calculated by using Equation 5 which is calculated to be E = 1- (5.38/6.64) ≈ 0.19 i.e. 19%.

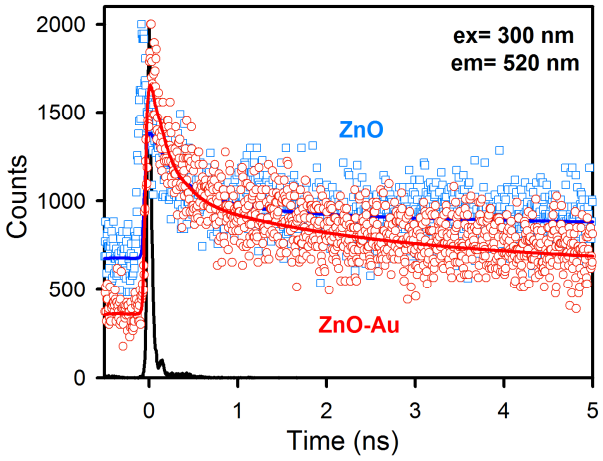

Figure S4. The picoseconds-resolved fluorescence transients of ZnO NPs, in the absence (blue) and presence of acceptor Au (red) (excitation at 300 nm) collected at 520 nm.

Table S1: Picosecond-resolved luminescence transients of ZnO NPs in the presence and absence of Au NPs[a]

Sample	τ_1	τ_2	τ_3	τ_{avg}
ZnO NP (bare)	28.49 ns (22%)	0.829 ns (32%)	0.241 ns (46%)	6.64 ns
ZnO-Au NC	24.35 ns (21%)	0.904 ns (19%)	0.160 ns (60%)	5.38 ns

[a]The emissions from ZnO NPs and ZnO-Au NCs (probing at 520 nm) were detected with a 300 nm laser excitation. Numbers in the parentheses indicate relative weightage.