Supplementary Information:

Fermi level shifts of gold nanospheres on ZnO film upon UV irradiation

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Fabrication of zinc oxide film and gold nanospheres

The zinc oxide films were realized by growth on c-plane sapphire substrates by employing the method of pulsed laser deposition from a sintered ZnO target (99.9995% pure) and with a KrF excimer laser. Afterwards, an annealing at 600°C was realized in O_2. Concerning to the fabrication of gold nanospheres (AuNS), they were produced by using the synthesis of Turkevich, which consists in the addition of a volume of 1 mL of trisodium citrate (8.5×10^{-4} M) to a boiling aqueous solution of 20 mL of $HAuCl_4$ with forceful agitation during 30 min. Thus, the mean diameter of obtained gold nanospheres is 30 nm.

Extinction measurements and Irradiation with UV light

For the extinction measurements, a Labram spectrometer was employed in a standard configuration of transmission with unpolarized white light, and the transmitted light was collected by using a microscope objective (×10; N.A. = 0.25). Regarding to UV irradiation, an UV quartz pencil lamp (λ = 254 nm with nominal output of 4.5 mW/cm^2) was used at a fixed distance of 2.4 cm above the substrate.

Calculation of total number of electrons n_e in the gold nanospheres

$$n_e = V \times \rho \quad \text{with} \quad V = V_{sgAuNS} \times N_{AuNS}$$

ρ is the free electron density in gold whose its value is 5.9×10^{22} cm^{-3}.
N_{AuNS} is the number of Au nanospheres present in the probed zone of $30 \times 30\ \mu m^2$ (here $N_{AuNS} \approx 1800$).
V_{sgAuNS} corresponds to the volume of a single Au nanosphere equal to $\frac{4}{3}\pi R^3$ where R is the Au sphere radius (here 15 nm).

$$n_e = V_{sgAuNS} \times N_{AuNS} \times \rho = 1.41 \times 10^{-17} \times 1800 \times 5.9 \times 10^{22} = 1.5 \times 10^9$$

Thus, the total number of electrons n_e in the gold nanospheres is worth 1.5×10^9.