Electronic Supplementary Information

Plasmon-mediated charge dynamics and photoactivity enhancement for Au-decorated ZnO nanocrystals

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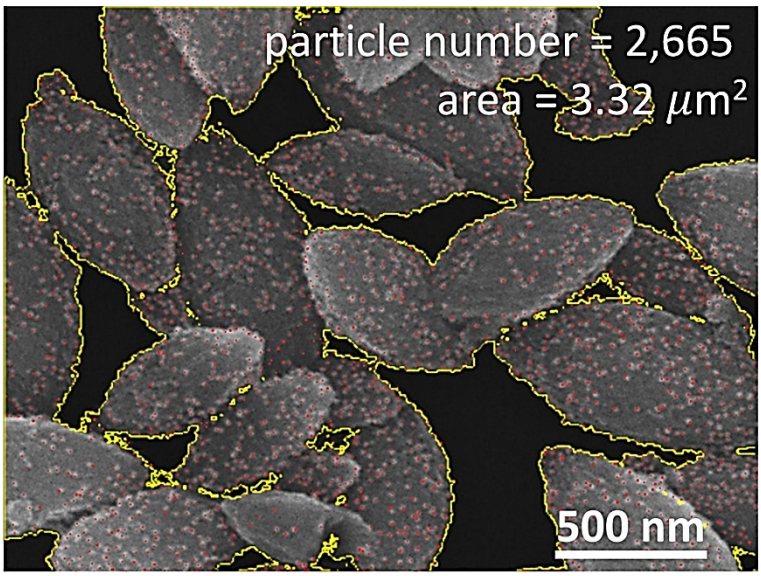

Fig. S1 SEM image used to determine Au particle density for ZnO-Au-6.0. The painted red and yellow colors represent the counting of Au particles and the delineated boundary of the supported ZnO, respectively. With the aid of graphic software, the number of Au particles (2,665 particles) and the corresponding area of the supported ZnO (3.32 μm^2) can be estimated in a scientifically rigorous manner, giving an Au particle density of 802.7 particles/ μm^2.

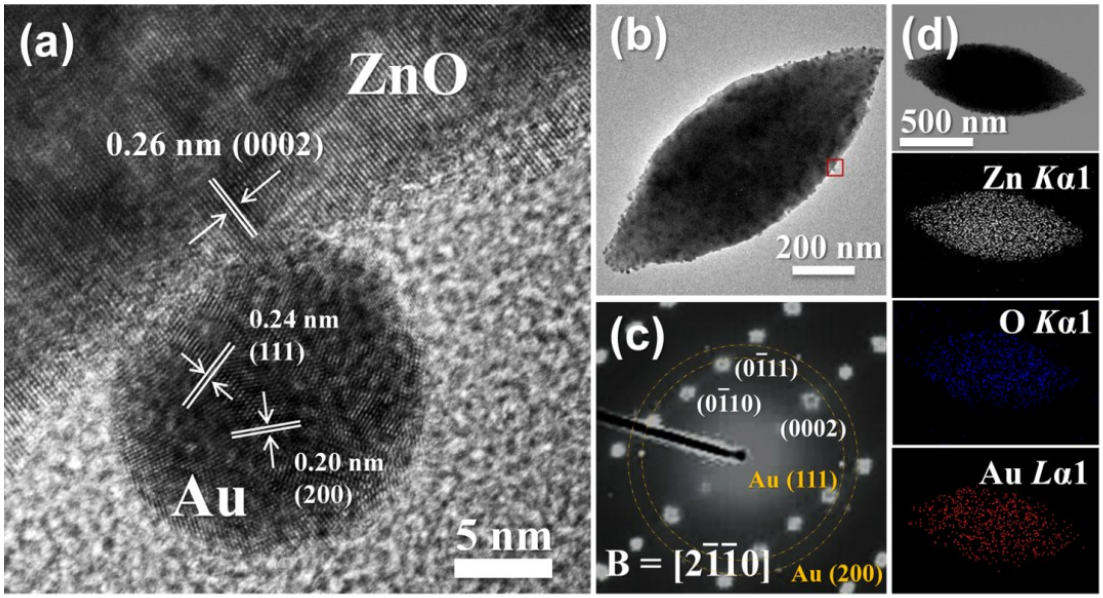

Fig. S2 (a) HRTEM image, (b) low-magnification TEM image, (c) SAED pattern, (d) TEM-EDS analysis for ZnO-Au-9.2.

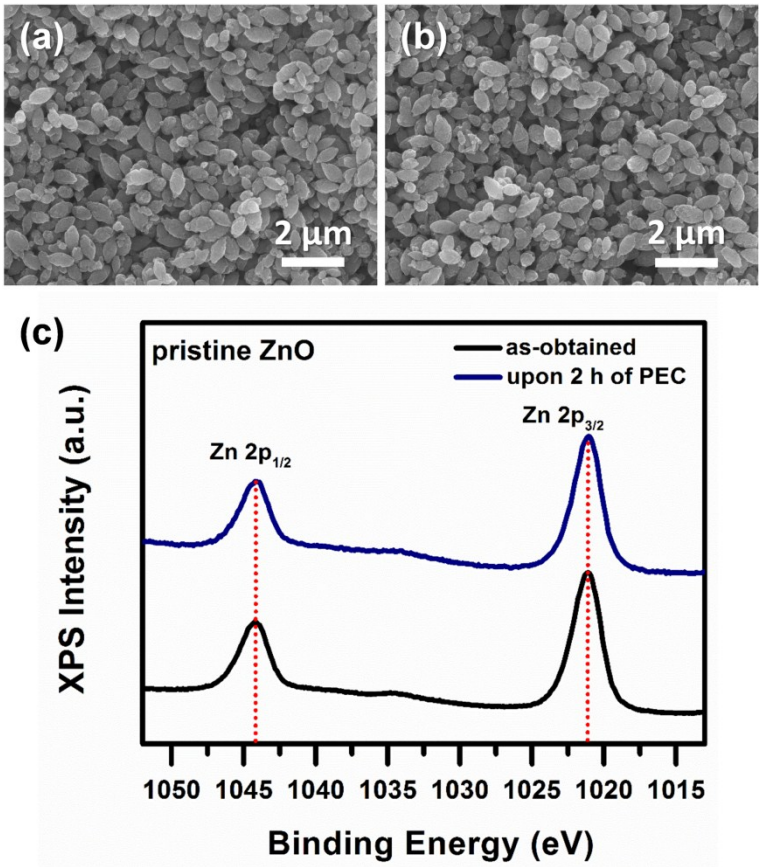

Fig. S3 SEM images of pristine ZnO (a) before and (b) after 2 h of PEC measurement. The corresponding XPS Zn 2p spectra were shown in (c), in which the recorded binding energies at 1021.0 eV (Zn 2p1/2) and 1044.1 eV (Zn 2p3/2) were consistent with the presence of ZnO.[1]

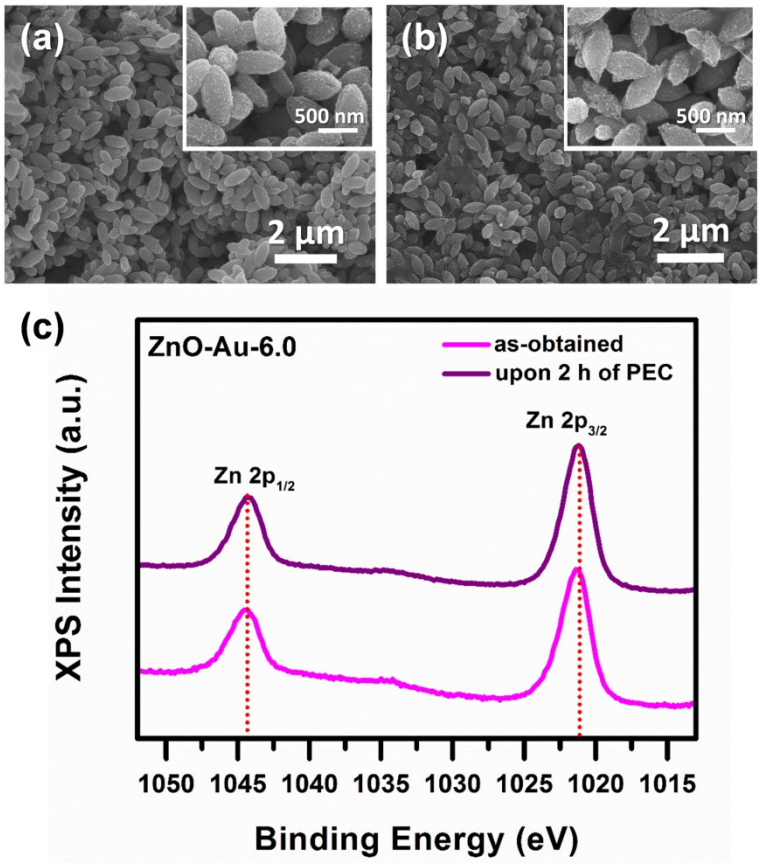

Fig. S4 SEM images of ZnO-Au-6.0 (a) before and (b) after 2 h of PEC measurement. Insets highlight the structural feature of Au particle decoration on ZnO surface. The corresponding XPS Zn 2p spectra were shown in (c), in which the recorded binding energies at 1021.0 eV (Zn $2p_{1/2}$) and 1044.1 eV (Zn $2p_{3/2}$) were consistent with the presence of ZnO.[1]

Table S1 Fitted results of time-resolved PL spectra for pristine ZnO and the four ZnO-Au electrodes.

entry (I) (320 nm pulses)	A_1 (%)	τ_1 (ns)	A_2 (%)	τ_2 (ns)	$\langle\tau\rangle$ (ns)	χ^2	k_{ct} (s^{-1})
pristine ZnO	25.5	4.28	74.5	0.58	3.23	1.11	-
ZnO-Au-1.7	7.0	3.19	93.0	0.46	1.40	1.06	4.05×10^8
ZnO-Au-3.5	6.5	2.39	93.5	0.46	0.98	1.02	7.11×10^8
ZnO-Au-6.0	6.1	2.30	93.9	0.35	0.94	1.05	7.54×10^8
ZnO-Au-9.2	6.5	2.37	93.5	0.42	0.97	1.08	7.21×10^8
entry (II) (320 nm pulses + 550 nm CW)	A_1 (%)	τ_1 (ns)	A_2 (%)	τ_2 (ns)	$\langle\tau\rangle$ (ns)	χ^2	k_{SPR} (s^{-1})
pristine ZnO	25.9	4.30	74.1	0.60	3.24	1.09	-
ZnO-Au-1.7	32.8	4.41	67.2	0.71	3.56	1.01	4.33×10^8
ZnO-Au-3.5	38.0	4.78	62.0	0.72	3.98	1.05	7.73×10^8
ZnO-Au-6.0	28.1	4.35	71.9	0.66	3.31	1.03	7.62×10^8
ZnO-Au-9.2	9.8	4.25	90.2	0.47	2.35	1.00	6.05×10^8

Table S2 Fitted parameters of the Nyquist plots for pristine ZnO and the four ZnO-Au electrodes.

entry	R_s (Ω)	R_{sc} (kΩ)	[a)]CPE$_{sc}$		R_{ct} (kΩ)	[a)]CPE$_{ct}$		f_{max} (Hz)	τ_n (ms)
			Q (μFs^{n-1})	n		Q (μFs^{n-1})	n		
pristine ZnO	38.27	31.91	24.68	0.87	60.92	21.11	0.88	17.58	9.06
ZnO-Au-1.7	23.12	5.86	26.79	0.88	38.51	17.84	0.95	37.28	4.27
ZnO-Au-3.5	15.17	4.96	28.16	0.90	36.62	17.86	0.88	115.14	1.38
ZnO-Au-6.0	14.98	0.15	81.36	0.74	9.86	64.31	0.89	215.44	0.74
ZnO-Au-9.2	29.12	0.18	72.31	0.76	17.73	51.69	0.86	167.68	0.95

[a)]CPE states the constant phase element and its impedance is given by $Z_{CPE} = Q^{-1}(jw)^{-n}$, in which Q is pseudocapacitance, w is the angular frequency, n is the CPE exponent ($0 \leq n \leq 1$), and j is the imaginary number. [2]

References

[1] F. Fan, P. Tang, Y. Wang, Y. Feng, A. Chen, R. Luo, D. Li, *Sens. Actuators B: Chem.*, 2015, **215**, 231–240.

[2] A. Allagui , H. Alawadhi, M. Alkaaby, M. Gaidi, K. Mostafa, Y. Abdulaziz, *Phys. Status Solidi A*, 2016, **213**, 139–145.