Electronic Supplementary Material (ESI) for Catalysis Science & Technology

TiO_2–Au nanocomposite materials embedded in polymer matrices and their application in the photocatalytic reduction of nitrite to ammonia

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Electronic Supplementary Information

Fig. S1:

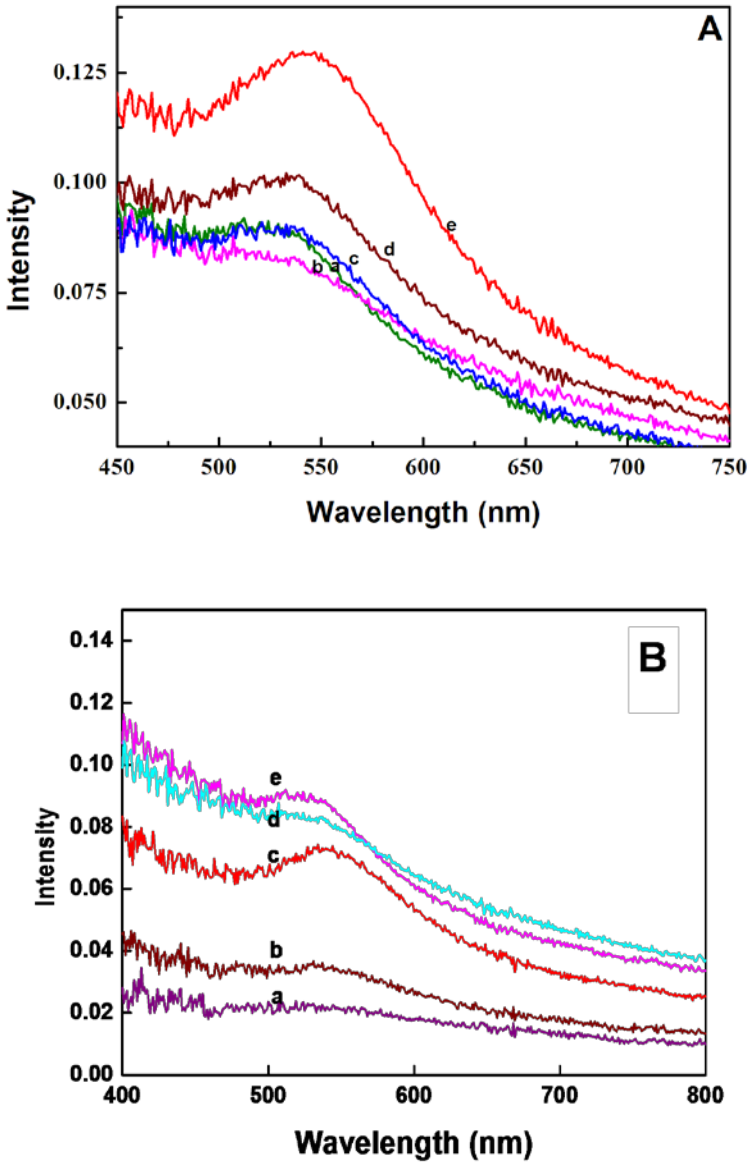
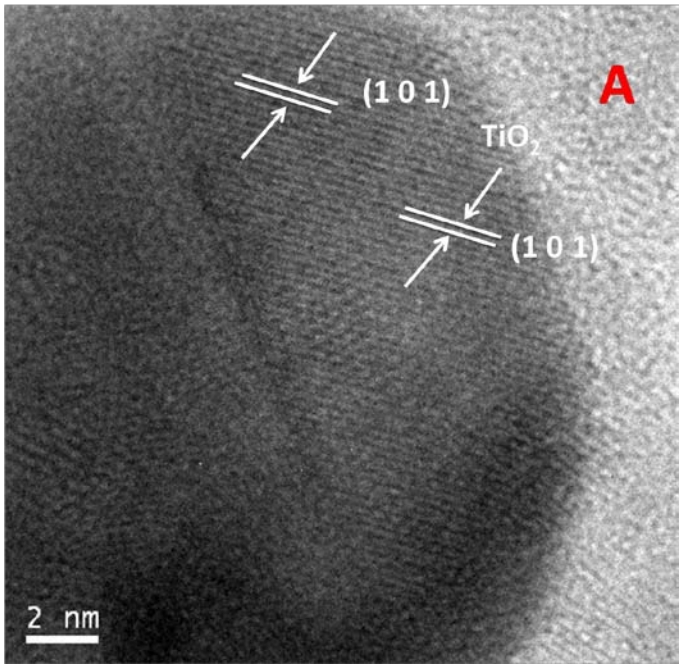
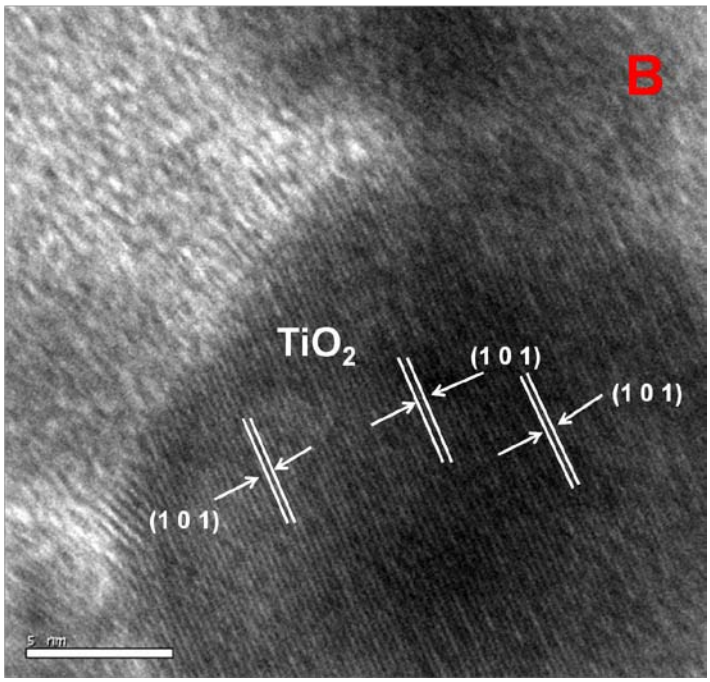


Fig. S1. Diffuse reflectance spectra of MTMOS/$(TiO_2–Au)_{nps}$ (A) and Nf/$(TiO_2–Au)_{nps}$ (B) film coated on glass plate. The molar ratios of TiO_2:Au are: 100:1 (a), 100:2 (b), 100:3 (c), 100:4 (d) and 100:5 (e).

Fig. S2:





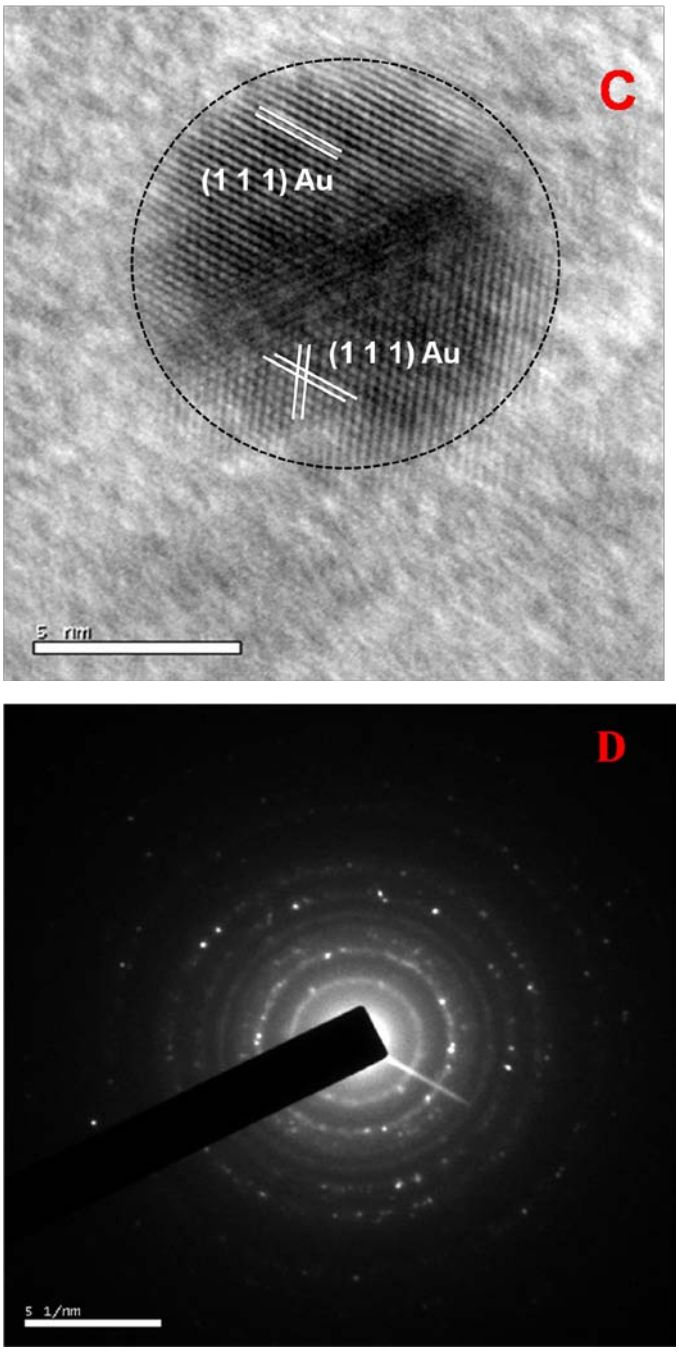


Fig. S2. Lattice resolved TEM images of TiO_2 nanoparticle alone (A), TiO_2 (B), Au (C) nanoparticles present in the $(TiO_2–Au)_{nps}$ nanocomposite material (Ti:Au = 33:1) and selected area electron diffraction (SAED) pattern of $(TiO_2–Au)_{nps}$ nanocomposite material (Ti:Au = 33:1) (D).

Fig. S3:

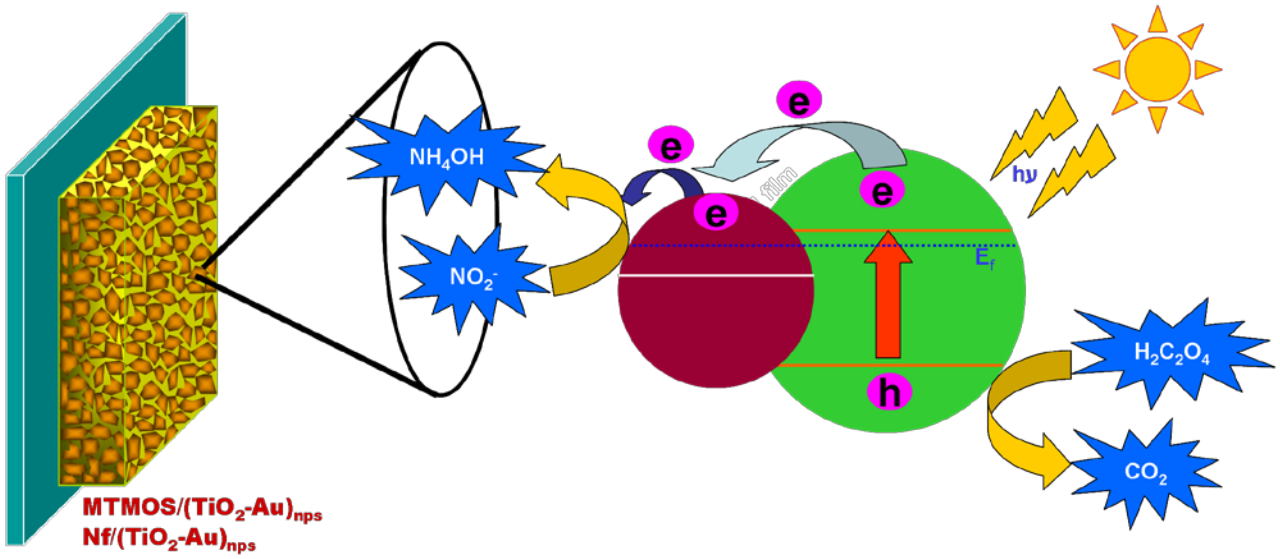


Fig. S3. Schematic representation for photocatalytic reduction of nitrite by $(TiO_2–Au)_{nps}$.

Table S1: Liquid uptake percentage of the polymer film.

Polymer film	Liquid uptake percentage (%)*
MTMOS	18
MTMOS/TiO_2	10
MTMOS/$(TiO_2$-Au$)_{nps}$ (Molar ratio of TiO_2:Au = 33:1)	16
Nf	23
Nf/TiO_2	19
Nf/$(TiO_2$-Au$)_{nps}$ (Molar ratio of TiO_2:Au = 33:1)	22

Foot note: Liquid uptake percentage of film was calculated by immersing the film in n-butanol for 12 h (Area of the film was 1 cm^2). The film was coated on a glass pate.

* The liquid uptake percentage of polymer film was determined by weight increase method as $(W_2-W_1)\times 100/W_1$, where W_1 and W_2 were the weights of polymer films before and after the absorption of the n-butanol, respectively.

Table S2: The band–gap energy and their corresponding wavelength for $(TiO_2–Au)_{nps}$, MTMOS/$(TiO_2–Au)_{nps}$ and Nf/$(TiO_2–Au)_{nps}$.

Photocatalyst	Without Matrix		In MTMOS		In Nafion	
	E_{bg} (eV)	λ (nm)	E_{bg} (eV)	λ (nm)	E_{bg} (eV)	λ (nm)
TiO_2	3.35	370	3.39	366	3.36	369
TiO_2–Au (100:1)	3.26	380	3.31	375	3.27	379
TiO_2–Au (50:1)	3.15	394	3.24	383	3.18	390
TiO_2–Au (33:1)	3.02	411	3.13	396	3.08	403
TiO_2–Au (25:1)	2.94	422	3.03	409	2.98	416
TiO_2–Au (20:1)	2.86	434	2.96	419	2.89	429

Table S3. Amounts of NH_4OH produced in the absence and presence of $[Ni(teta)]^{2+}$ at the MTMOS/$(TiO_2–Au)_{nps}$ and Nf/$(TiO_2–Au)_{nps}$ films when dipped in a mixture containing 1 mM $NaNO_2$ and 5 mM oxalic acid in 20 mL. The irradiation time was 1 hr.

Photocatalyst	**Amount of NH_4OH (μM)**			
	Absence of $[Ni(teta)]^{2+}$		Presence of $[Ni(teta)]^{2+}$	
	MTMOS	Nafion	MTMOS	Nafion
TiO_2	51.5	126	80.5	200.5
TiO_2–Au (100:1)	92.5	159	144.9	240.5
TiO_2–Au (50:1)	107	180	152.5	281
TiO_2–Au (33:1)	159	196	216	318
TiO_2–Au (25:1)	138.5	195.5	197	308
TiO_2–Au (20:1)	137.5	194	191.5	302.5

Table S4. Photocataltyic reduction of nitrite to ammonia with various photocatalysts in colloidal systems and films.

Photocatalyst	Nature of the Catalyst	Irradiation Time	Sacrificial Electron Donors	Amount of ammonia produced (μ mol in 20 mL)	References
MTMOS/$(TiO_2$-$Au)_{nps}$/$[Ni(teta)]^{2+}$ (TiO_2:Au molar ratio was 33:1)	Film	1 h	OA	4.32	Present work
Nf/$(TiO2$-$Au)_{nps}$//$[Ni(teta)]^{2+}$ (TiO_2:Au molar ratio was 33:1)	Film	1 h	OA	6.36	Present work
Nf/FePc	Film	1 h	TEA	3.0	34
Nf/$[Ni(teta)]^{2+}$/$[Ru(bpy)_3]^{2+}$	Film	1 h	TEA	1.1	33
0.04 wt. % Fe/TiO_2 (Doping)	Colloids	2 h	Water	0.67	30
0.23 wt. % Cr/TiO_2 (Doping)	Colloids	2 h	Water	0.25	30
0.25 wt. % Co/TiO_2 (Doping)	Colloids	2 h	Water	0.37	30
1.41 wt. % Mg/TiO_2 (Doping)	Colloids	2 h	Water	0.55	30
Sol-gel TiO_2	Colloids	2 h	Water	6.47	32