Light driven water oxidation on silica supported NiO-TiO_2 heteronanocrystals yields hydrogen peroxide

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Supporting information

Contents

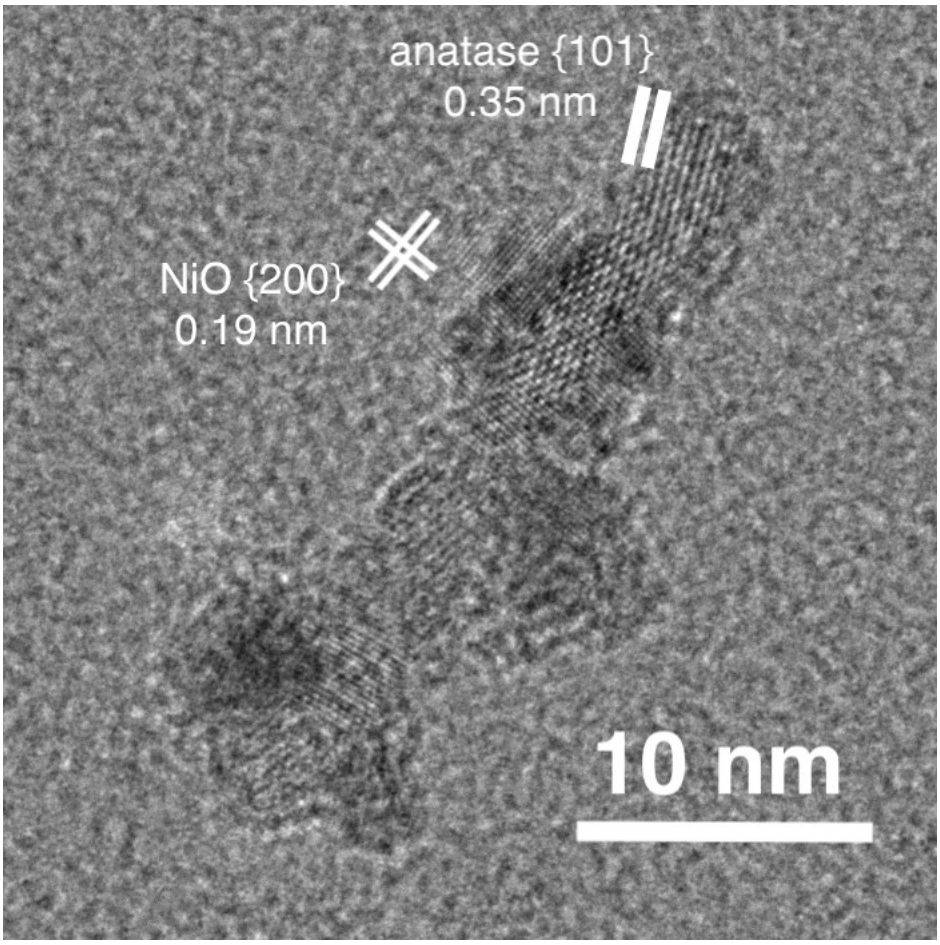

Figure S1. HRTEM image of NiO-TiO_2 heteronanocrystal.

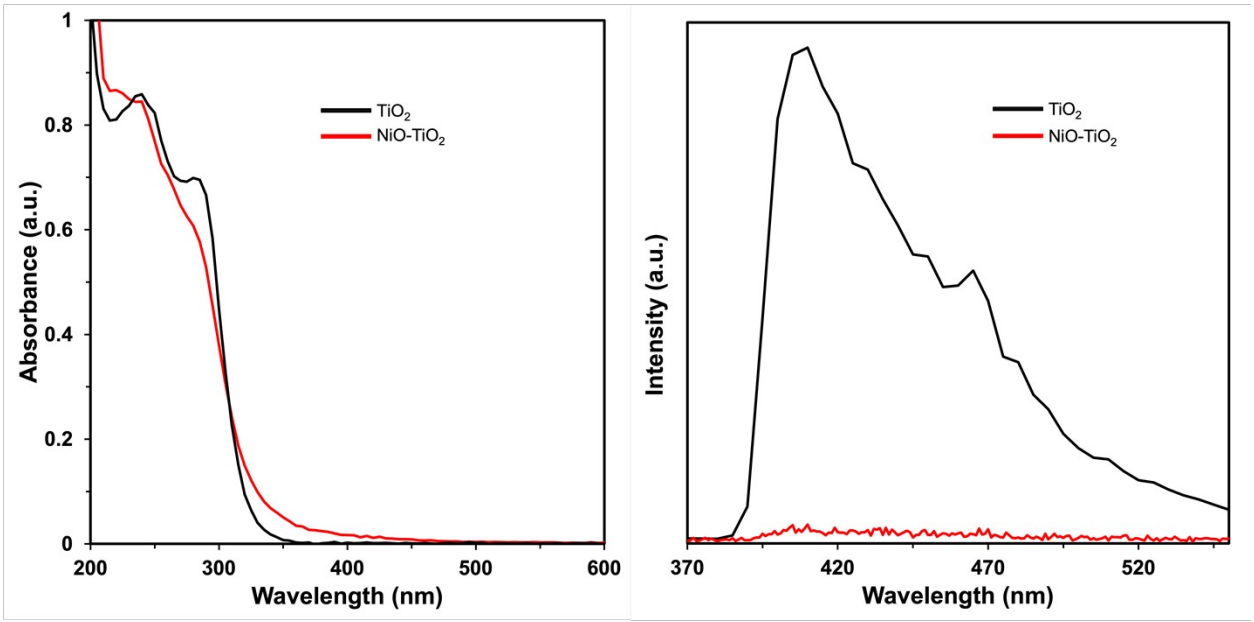

Figure S2. A) UV-Visible absorption spectra of dilute dispersions of TiO_2, TiO_2-NiO, and B) Photoluminescence emission spectra (λ_{ex} = 300 nm) of *anatase* TiO_2 and TiO_2-NiO HNCs.

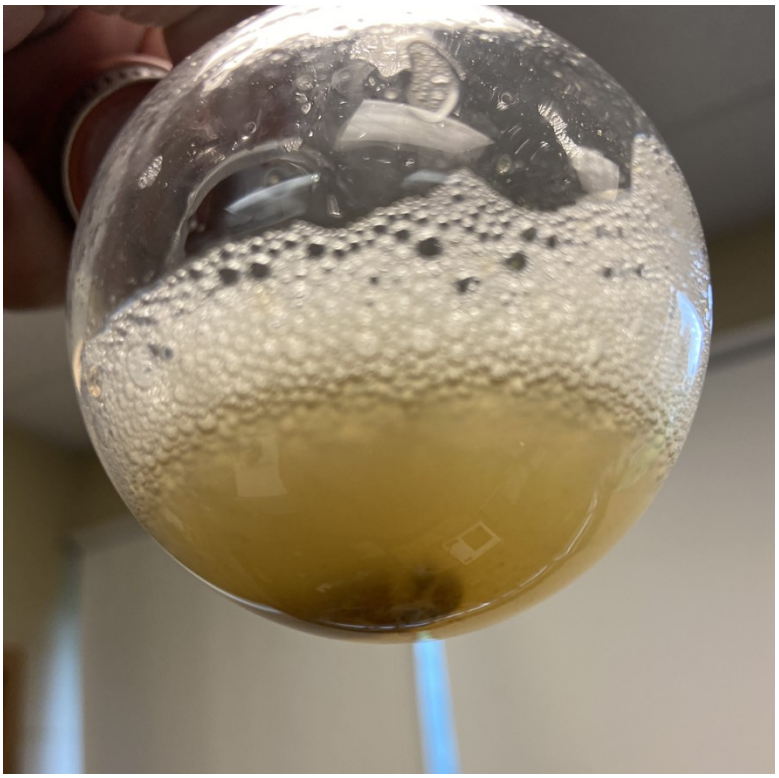

Figure S3. Photograph of aqueous suspension of SiO_2/NiO-TiO_2 (NiO-TiO_2 heteronanocrystals supported on fumed silica) after 24 hours illumination with unfiltered light from 150W Xe arc lamp.

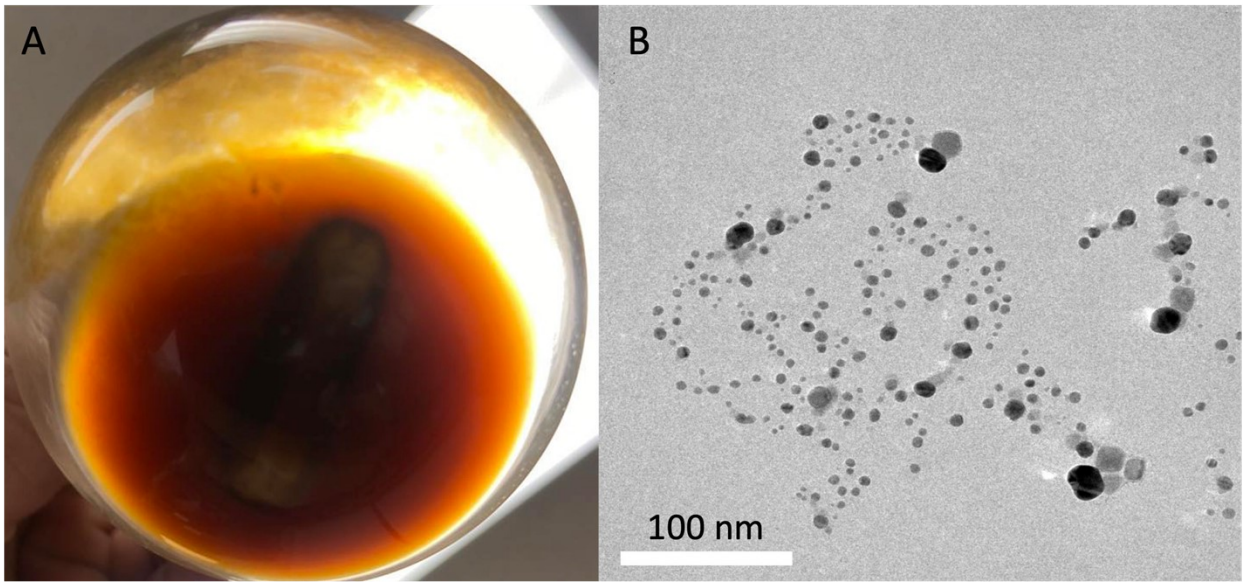

Figure S4. Irradiation of SiO_2/NiO-TiO_2 in dilute aqueous silver nitrate leads to formation of Ag nanoparticles. A) Photograph of the catalyst suspension after irradiation. B) TEM image of Ag nanoparticles.

Alternatively, we demonstrate a fast colorimetric test for hole scavenging upon irradiation of aqueous, anaerobic Fe^{2+} and thiocyanide ion that gives dark red colored solutions upon oxidation to Fe^{3+} (Figure S2). In these conditions, the absorbance at 450 nm abruptly rises, then decreases to a constant value that we presume is due to the back-reaction in which Fe^{3+} is reduced back to Fe^{2+} by photogenerated electrons on TiO_2.

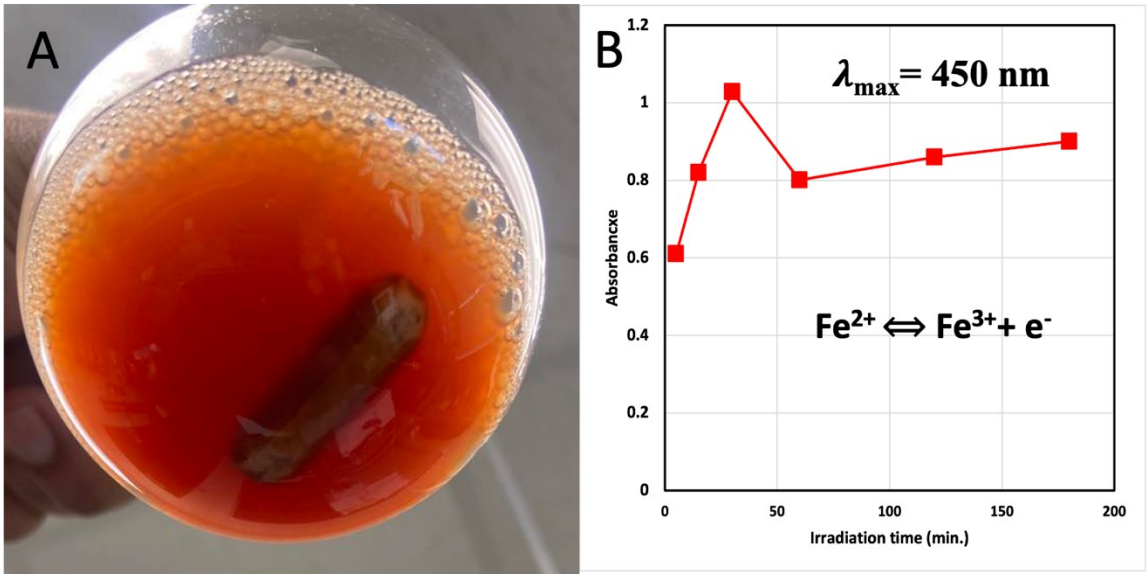

Figure S5. a) Formation of an iron (III) thiocyanate complex ion $Fe(SCN)^{2+}$ from Fe^{3+} and SCN^- in the reaction vessel b) absorbance maxima λ_{max}= 450 nm of $Fe(SCN)^{2+}$ taken at desired time interval.

Analysis of EDS data for NiO-TiO2 heteronanocrystal sample.

2023-07-07 11:49:39 Analysis of spectrum: Spectra from Area #1 (Brown-Powell general)

Z	Element	Family	Atomic Fraction (%)		Atomic Error (%)		Mass Fraction (%)
	Mass Error (%)		Fit error (%)				
6	C	K	72.91	5.19	57.99	2.48	0.09
7	N	K	0.00	0.04	0.00	0.04	0.00
8	O	K	18.47	3.92	19.57	4.00	0.15
11	Na	K	1.59	0.33	2.42	0.49	0.24
13	Al	K	2.02	0.42	3.60	0.73	0.23
14	Si	K	0.84	0.17	1.56	0.31	0.46
15	P	K	0.21	0.04	0.43	0.08	2.18
19	K	K	0.34	0.06	0.87	0.16	0.88
22	Ti	K	0.75	0.11	2.38	0.33	0.38
26	Fe	K	0.16	0.02	0.59	0.08	1.26
28	Ni	K	2.73	0.41	10.60	1.48	0.12

2023-07-07 11:52:58 Analysis of spectrum: Spectra from Area #1 (Schreiber-Wims oxide-optimized)

Z	Element	Family	Atomic Fraction (%)		Atomic Error (%)		Mass Fraction (%)
	Mass Error (%)		Fit error (%)				
6	C	K	69.25	5.28	52.23	2.38	0.09
7	N	K	0.00	0.04	0.00	0.04	0.00
8	O	K	19.87	4.25	19.97	4.10	0.15
11	Na	K	1.83	0.39	2.64	0.54	0.24
13	Al	K	2.35	0.50	3.99	0.81	0.23
14	Si	K	0.99	0.20	1.74	0.34	0.46

15	P	K	0.25	0.05	0.48	0.09	2.18
19	K	K	0.41	0.08	1.00	0.18	0.88
22	Ti	K	0.94	0.14	2.82	0.40	0.38
26	Fe	K	0.21	0.03	0.75	0.11	1.26
28	Ni	K	3.90	0.60	14.39	2.03	0.12