Supplementary materials for

Bimetallic Pt-IrO_x/g-C_3N_4 photocatalysts for the highly efficient overall water splitting under visible light

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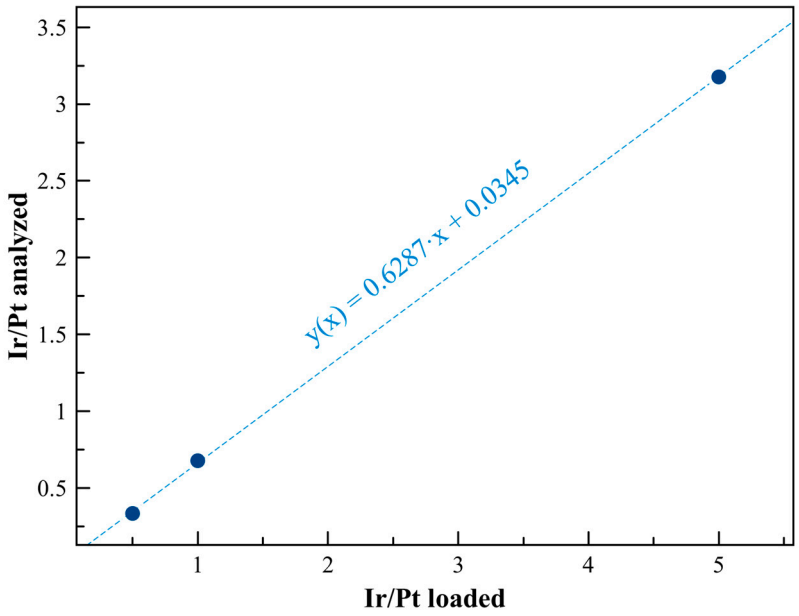

Figure S1. Correlation between loaded Ir:Pt ratios and the same value determined with ICP AES chemical analysis in the as prepared $Ir_xPt_{0.1}$/ g-C_3N_4(1) catalysts (x = 0.5, 0.1, 0.01).

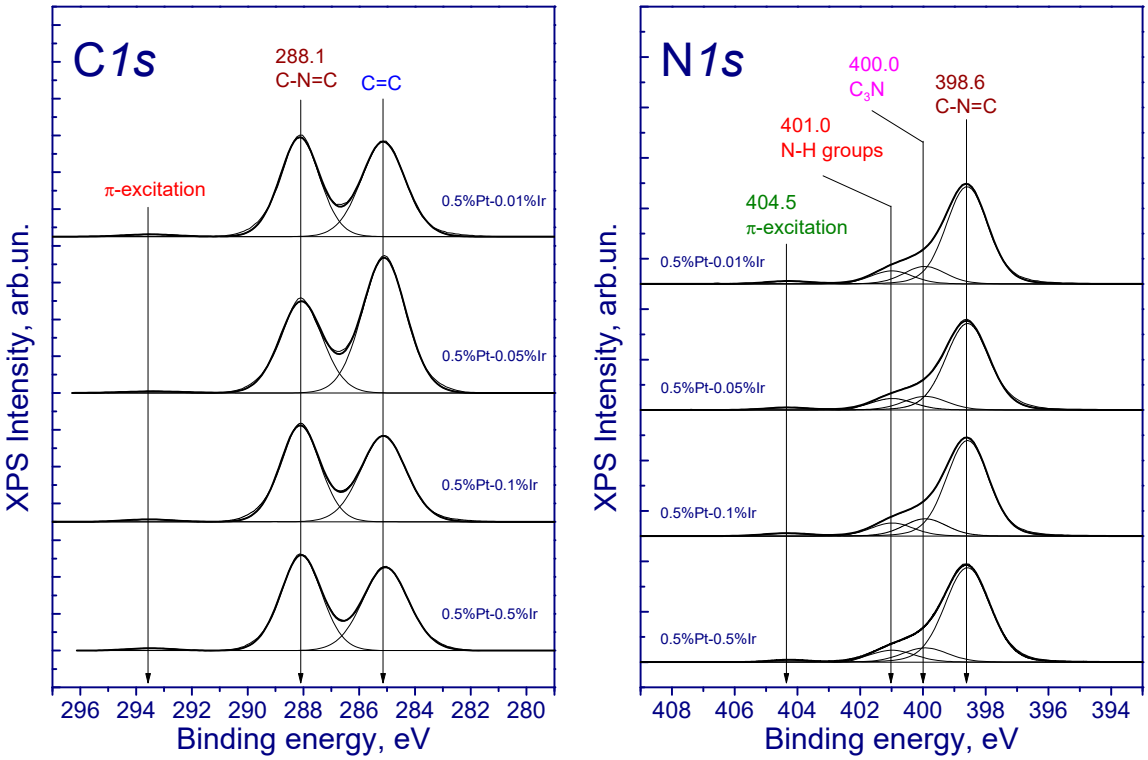

Figure S2. C1s and N1s core-level spectra of photocatalysts. The N1s spectra are normalized to the integral intensity of the C1s peaks corresponding to the spectrum of g-C_3N_4.

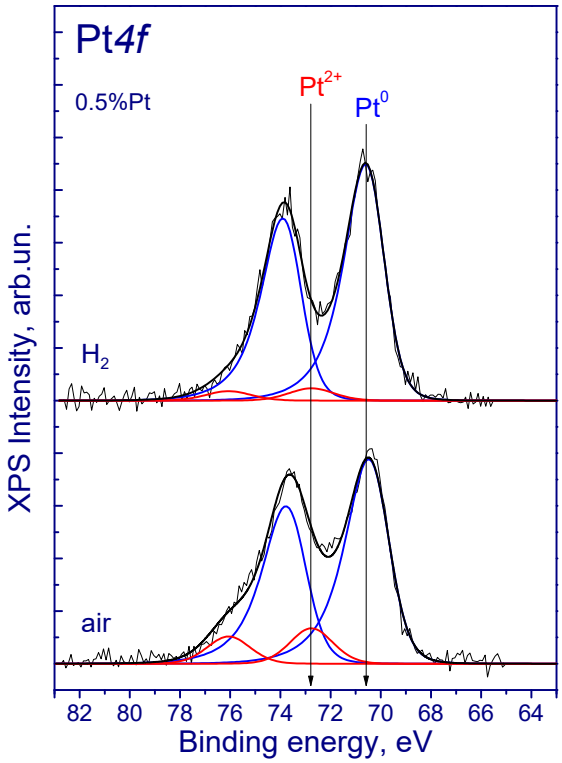

Figure S3. XPS spectra of Pt4f of the photocatalysts $Pt_{0.5}$/g-C_3N_4 after treatment and hydrogen and consecutive treatment in air. Spectra are normalized to the integral peak intensity C1s corresponding to the carrier spectrum (g-C_3N_4).

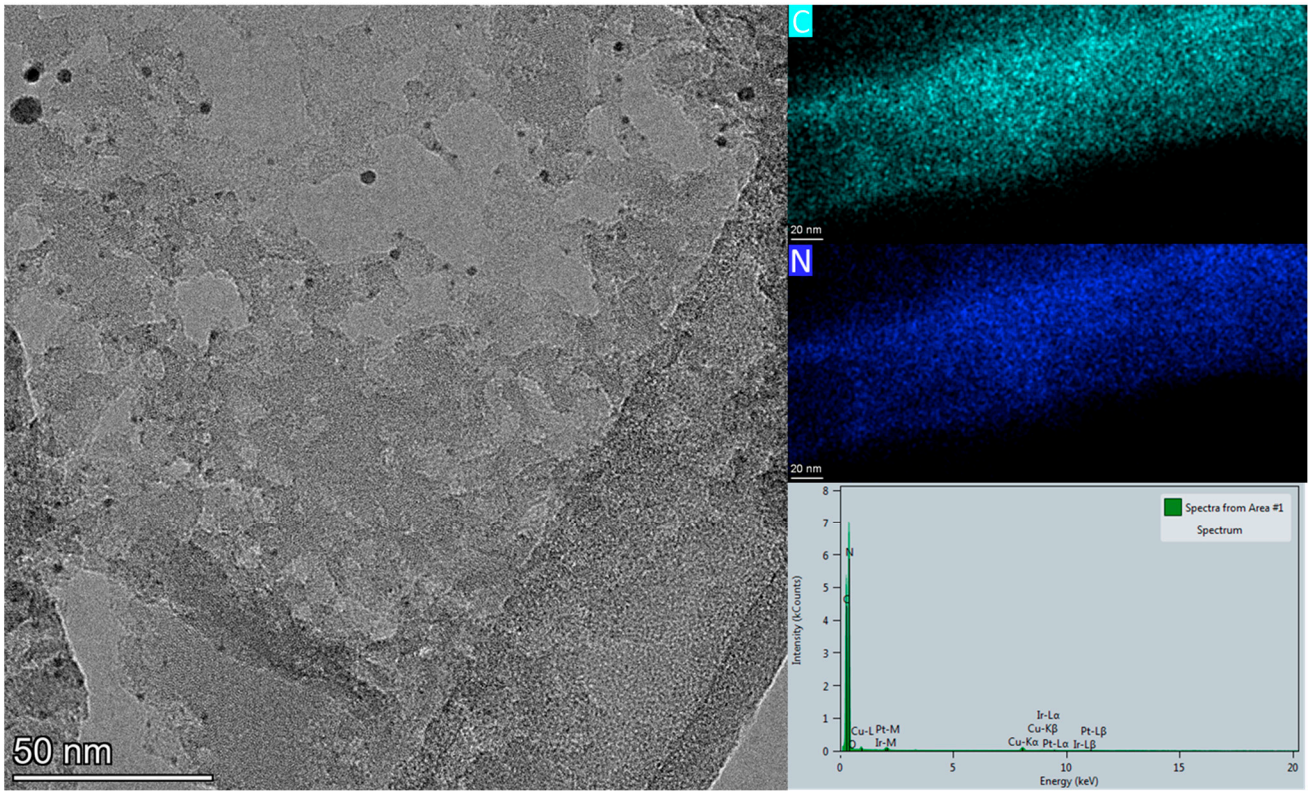

Figure S4. HR-TEM of the $Ir_{0.5}Pt_{0.5}$/g-C_3N_4(1) photocatalyst, EDS mapping of the C and N elements in the $Ir_{0.5}Pt_{0.5}$/g-C_3N_4(1) photocatalyst and spectrum from EDS mapping.

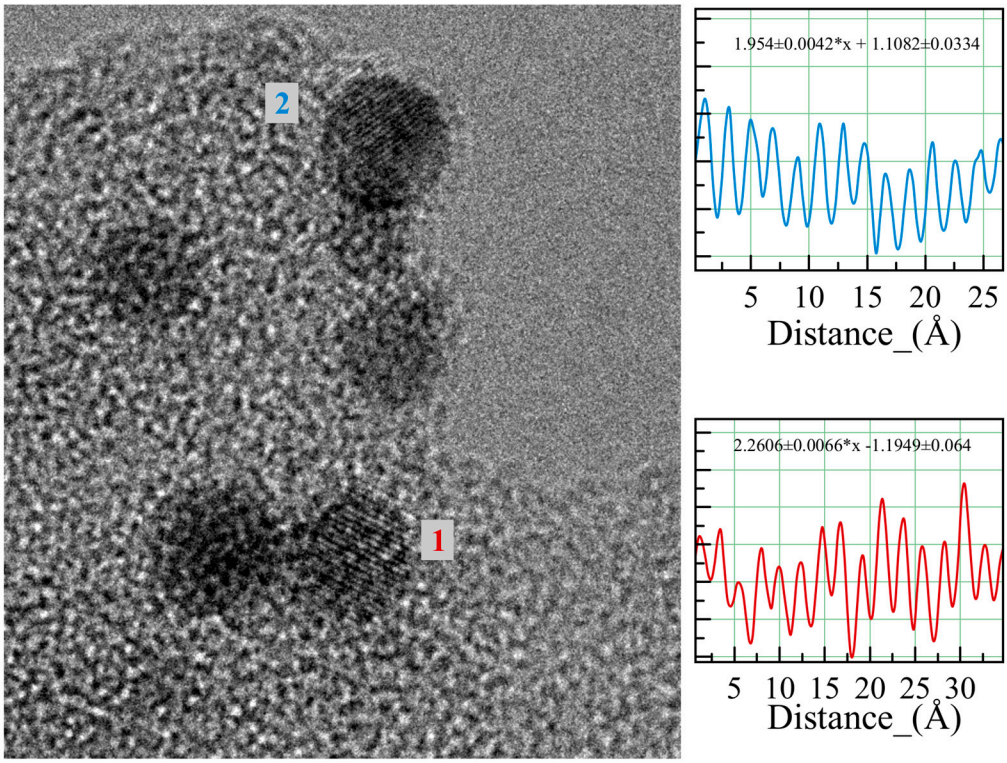

Figure S5. Analysis of the interplanar distances observed in HR-TEM micrographs of Pt nanoparticles in the $Ir_{0.5}Pt_{0.5}$/g-C_3N_4(1) photocatalyst.

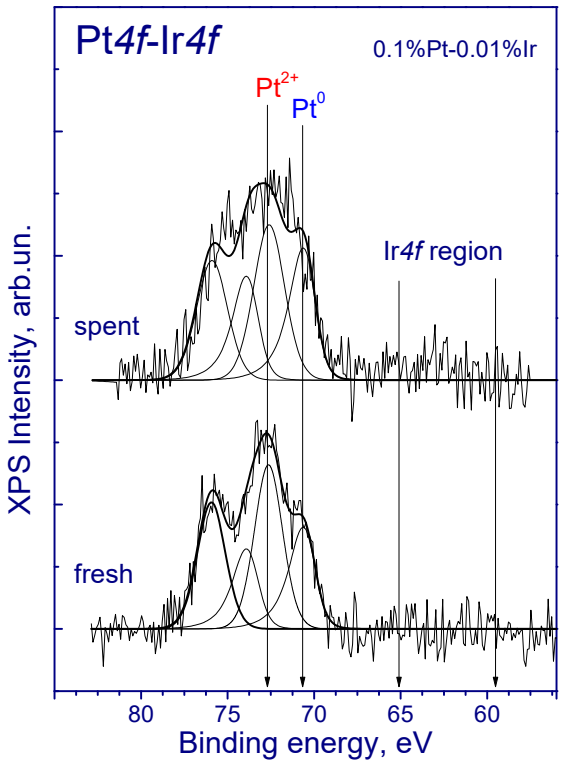

Figure S6. XPS spectra of Pt4f and Ir4f of the spent and fresh $Ir_{0.01}Pt_{0.1}$/ g-C_3N_4(1) photocatalyst. Spectra are normalized to the integral peak intensity C1s corresponding to the carrier spectrum (g-C_3N_4).

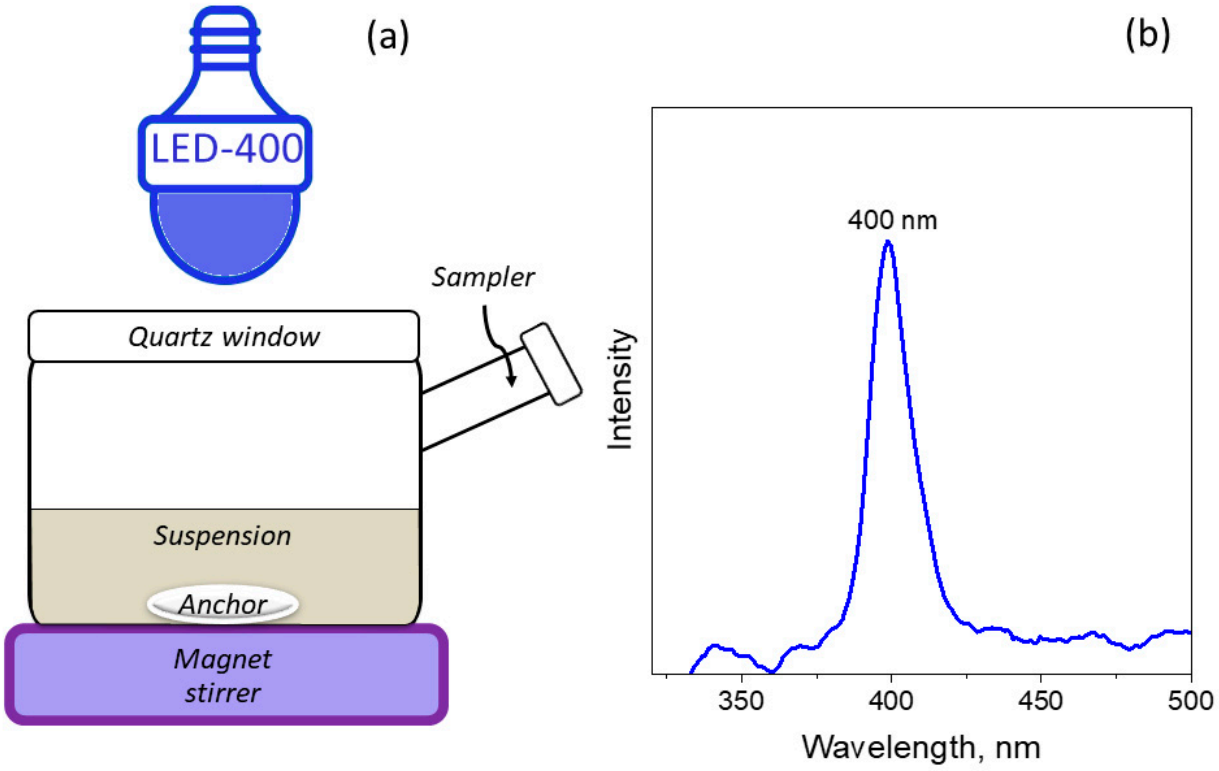

Figure S7. (**a**) The scheme of photocatalytic reactor utilized in this work and (**b**) the spectrum of 400 nm LED used for irradiation of catalysts suspensions.

Table S1. The percentage composition of all elements calculated from spectrum from EDS mapping.

Element	Mass fraction, %	Mass error, %
C	47.87	4.91
N	51.06	11.48
O	0.00	0.02
Ir	0.13	0.14
Pt	0.94	0.14

Table S2. Data on the photocatalytic hydrogen and oxygen evolution from water without the addition of electron donors.

Photocatalyst	Experimental conditions	Light source	Activity, μmol H_2 $g_{cat}^{-1}h^{-1}$	Activity, μmol O_2 $g_{cat}^{-1}h^{-1}$	Ref.
3%Pt/0.5%CoP/g-C_3N_4	deionized H_2O 100 ml pH = 3 photocatalyst 28 mg	300 W Xe lamp with cut-off filter λ>420 nm	14.7	7.4	[8]
CdS/1.3% Ni_2P/g-C_3N_4	ultrapure H_2O 50 ml photocatalyst 50 mg	300 W Xe lamp with cut-off filter λ>420 nm	11.2	5.5	[13]
3%Pt/10%MnO_2/g-C_3N_4	pure H_2O 100 ml photocatalyst 20 mg	300 W Xe lamp with cut-off filter λ>400 nm	60.6	28.9	[3]
3%Pt/$BiVO_4$/g-C_3N_4	pure H_2O 100 ml photocatalyst 100 mg	300 W Xe lamp with cut-off filter λ>420 nm	156	73	[44]
1%Pt/g-C_3N_4/ITO/Co-$BiVO_4$	pure H_2O 100 ml photocatalyst 30 mg	300 W Xe lamp	95.4	40.2	[45]
0.5%Pt/0.13%Co/g-C_3N_4	pure H_2O 50 ml photocatalyst 20 mg	300 W Xe lamp with cut-off filter λ>400 nm	85.7	21.3	[46]
7%$Co_{0.6}Ni_{1.4}P$/CdS/g-C_3N_4	pure H_2O 100 ml photocatalyst 30 mg	300 W Xe lamp with cut-off filter λ≥420 nm	122.0	57.5	[47]
1%Pt/3%IrO_2/g-C_3N_4	distilled H_2O 100 ml photocatalyst 50 mg	300 W Xe lamp with cut-off filter λ≥420 nm	101	49.1	[6]

Table S3. Data on the photocatalytic hydrogen and peroxide evolution from pure water presented in the literature.

Photocatalyst	Experimental conditions	Light source	Activity, μmol H_2 $g_{cat}^{-1}h^{-1}$	Activity, μmol H_2O_2 $g_{cat}^{-1}h^{-1}$	Ref.
64 wt.% $CdS@ZnIn_2S_4$	100 ml pure water 15 mg photocatalyst	Xe lamp 300 W with filter $\lambda > 400$ nm	540.3	604.8	[54]
8.3 wt.% carbon dots/CoP	20 ml ultrapure water 10 mg photocatalyst	White LED (420 nm ≤ $\lambda < 700$ nm)	239.0	466.0	[52]
0.5 wt.% $CoO/TiO_2/SiO_2$	25 ml ultrapure water 40 mg photocatalyst	White LED (420 nm ≤ $\lambda < 700$ nm, 5 W)	1460.0 μmol H_2 $g_{CoO}^{-1}h^{-1}$ (7.30 μmol H_2 $g_{cat}^{-1}h^{-1}$)	1390.0 μmol H_2O_2 $g_{CoO}^{-1}h^{-1}$ (6.95 μmol H_2O_2 $g_{cat}^{-1}h^{-1}$)	[18]
1 wt.% Pt/1.45 wt.% Na^+-doped-g-C_3N_4	200 ml deionized water 200 mg photocatalyst	Sodium lamp high-pressure 250 W (400 < λ < 800 nm)	900.0	880.0 μmol H_2O_2 g_{cat}^{-1} (146.7 μmol H_2O_2 $g_{cat}^{-1}h^{-1}$)	[24]
1 wt.% Pt/2.3 wt.%K^+-doped-g-C_3N_4	200 ml deionized water 200 mg photocatalyst	Sodium lamp high-pressure 250 W (400 < λ < 800 nm)	550.0	620.0 μmol H_2O_2 g_{cat}^{-1} (103.3 μmol H_2O_2 $g_{cat}^{-1}h^{-1}$)	[20]
Co_xP/P-doped-g-C_3N_4 (x=1 or 2)	80 ml pure water 50 mgphotocatalyst	300 W Xe lamp (incident light density = 450 mW/cm^{-2}) with cut off filter λ≥420 nm	75.0 μmol H_2 (300.0 μmol H_2 $g_{cat}^{-1}h^{-1}$)	70.0 μmol H_2O_2 (280.0 μmol H_2O_2 $g_{cat}^{-1}h^{-1}$)	[48]
Au nanoparticles/Oxigen vacansies $BiOBr/TiO_2$ (P25)	100 ml deionized water 50 mg photocatalyst	Xe lamp 300 W	384.0	200.0	[55]
Ni_2P/carbon dots-x (x=20 mg)	20 ml ultrapure water 10 mg photocatalyst	$\lambda > 420$ nm	256.6	1281.4	[49]
3% Co-doped-mesoporous g-C_3N_4	25 ml ultrapure water 10 mg photocatalyst	White LED	1.82 μmol H_2 h^{-1}	1.65 μmol H_2O_2 h^{-1}	[53]

		(420 nm ≤ λ < 700 nm) Xe lamp 300 W with cut off filter λ > 325 nm	(182.0 μmol H_2 $g_{cat}^{-1}h^{-1}$)	(165.0 μmol H_2O_2 $g_{cat}^{-1}h^{-1}$)	
5% black P nanodots/$Ti_3C_2T_x$@TiO_2	100 ml pure water 10 mg photocatalyst		564.8	400.0	[50]
1 wt.% Ni/3 wt.% CoP/ P-doped-g-C_3N_4	60 ml water 50 mg photocatalyst	Xe lamp	124.0	447.0	[51]