Electronic Supplementary Material (ESM)

Environmentally sustainable synthesis of $CoFe_2O_4$-TiO_2/rGO ternary photocatalyst: A highly efficient and stable photocatalyst for high production of hydrogen (Solar Fuel)

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Section S1: Apparent Quantum Yield (A.Q.Y) efficiency Calculation

We have calculated the quantum efficiency in order to compare the photocatalytic activity of photocatalysts by using 400 nm band pass filter.

A.Q.Y Calculation details

The energy of one photon (*E* photon) with wavelength of λ_{inc} (nm) is calculated using the following equation.

$$E_{photon} = \frac{hc}{\lambda_{inc}}$$

Total energy of the incident light (E_{total})

$$E_{total} = PSt$$

Therefore,

Quantum yield (Q.Y.)

$$Q.Y\ (\%) = \frac{\text{Number of reacted electrons}}{\text{Number of incident photons}} \times 100$$

Or

$$A.Q.Y\ (\%) = \frac{2 \times (\text{Number of } H_2 \text{ molecules evolved})}{\text{Number of incident photons}} \times 100$$

$$A.Q.Y\ (\%) = \frac{2 \times M \times N_A \times h \times c}{P \times S \times t \times \lambda_{inc}} \times 100$$

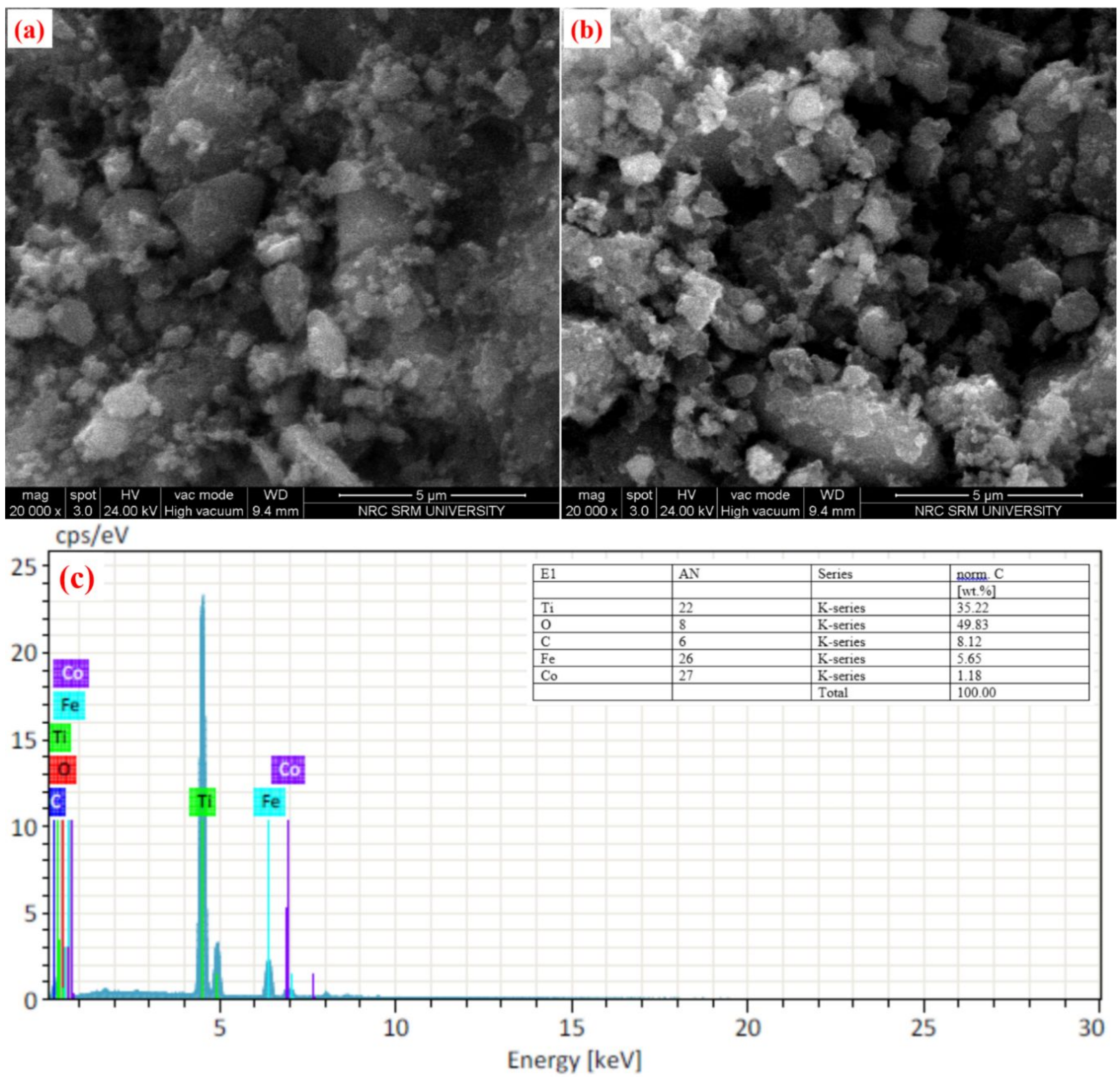
Where

$M = \text{Amount of hydrogen produced in } \frac{\text{mol}}{\text{time}} = 2732\ \mu\text{mol/h}$

N_A = Avogadro Number = 6.022×10^{23}
c = Speed of light = $3 \times 10^{8}\ \text{ms}^{-2}$
h = Planck's constant = 6.626×10^{-34} Js
P = Power density of the incident monochromatic light = 100 mW/cm^2)
S = Irradiated area to produce M (mol) of hydrogen = 35 cm^2
t = Irradiated time = 1 h = 3600 s
λ_{inc} = wavelength of the incident monochromatic light = 400 nm = 400×10^{-9} m

$$\text{A.Q.Y}\ (\%) = \frac{2 \times 2732 \times 10^{-6} \times 6.022 \times 10^{23} \times 6.626 \times 10^{-34} \times 3 \times 10^{8}}{100 \times 10^{-3} \times 35 \times 3600 \times 400 \times 10^{-9}} \times 100$$

$$\text{A.Q.Y}\ (\%) = 12.97\ \%$$



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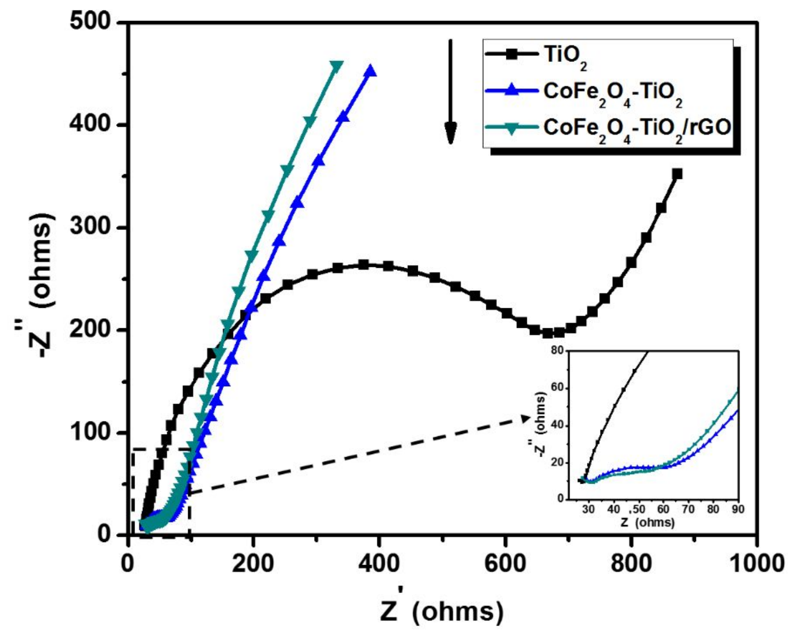

Figure S2. Impedance measurement of TiO_2, $CoFe_2O_4$-TiO_2 and $CoFe_2O_4$-TiO_2/rGO photocatalysts

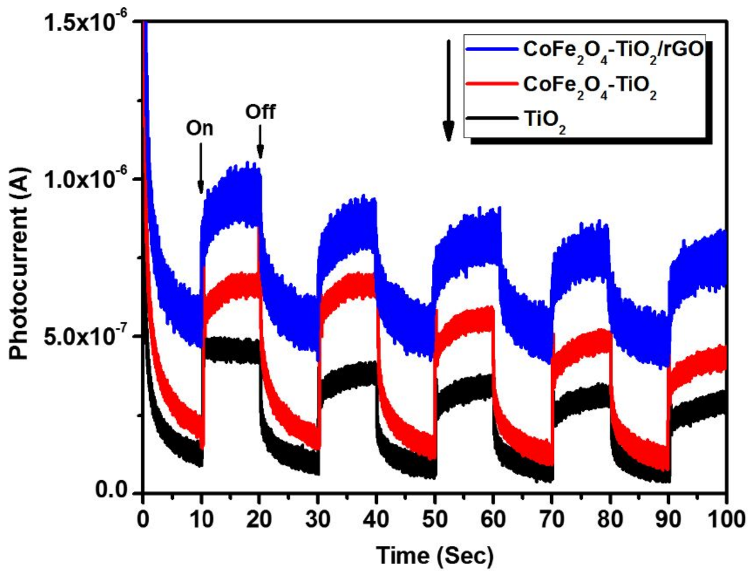

Figure S3. Photocurrent studies of TiO_2, $CoFe_2O_4$-$TiO_2$and $CoFe_2O_4$-TiO_2/rGO photocatalysts

Table S1 Photocatalytic H_2 production comparison with existing TiO_2 based materials

Photocatalysts	Co-catalysts	Hole Scavengers	Irradiation Source	H_2 production ($\mu mol\ g^{-1}h^{-1}$)	Ref (year)
TiO_2	$CuFe_2O_4$/rGO	Glycerol	250 W Xe	35981	[1] (2018)
TiO_2	MWT/rGO	Glycerol	250 W Xe	29000	[2] (2019)
TiO_2	$Ni(OH)_2$	Glycerol	300 Xe Lamp	4719	[3] (2018)
TiO_2	NiS	Methanol	300 Xe Lamp	655	[4] (2018)
TiO_2	$Ni(HCO_3)_2$	Methanol	300 Xe Lamp	1798	[5] (2017)
TiO_2	CuxS	Methanol	300 Xe Lamp	5620	[6] (2018)
TiO_2	$ZrCO_2$/rGO	Glycerol	Solar light	7773	[7] (2018)
TiO_2	CuS	Na_2SO_3 & Na_2S	300 Xe Lamp	1262	[8] (2018)
TiO_2	CdS	Na_2SO_3 & Na_2S	300 Xe Lamp	1048	[9] (2017)
TiO_2	$CuOCr_2O_3$	Glycerol	Solar light	70400	[10] (2018)
TiO_2	Bi_2O_3	Glycerol	Solar light	26020	[11] (2017)
TiO_2	Cu_2O/rGO	Glycerol	300 Xe Lamp	110 968	[12] (2015)
TiO_2	$InVO_4$/rGO	Glycerol	250 Xe Lamp	33980	[13] (2019)
TiO_2	**$CoFe_2O_4$/rGO**	**Glycerol**	**250 Xe Lamp**	**76559**	**This**

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