Supporting Information

Structural characterization:

The phase structure and crystallinity of the prepared catalysts were observed by Powdered X-ray diffraction (XRD) analysis. The Powdered X-ray diffraction were recorded on a Bruker AXS diffractometer (D8 advance) at a generator voltage of 40kv and 30 mA current using cu-Kα. radiation (λ=1.5406 Å). The samples were scanned in the range of (2 θ=5-100) with the scan rate 1s/step. Field emission scanning electron microscopic (FESEM) characterization was done on FEI Nova Nano SEM-450.Transmission electron Microscopy (TEM) image of the representative TNR sample was obtained by using a JEOL 2010EX TEM instrument equipped with the high resolution objective –lens pole piece at an acceleration voltage of 200Kv fitted with a CCD camera. The optical properties were characterized by using UV-vis diffuse reflectance spectroscopy (DRS) Perkin Elmer Lambda 750) equipped with an integral sphere using $BaSO_4$ as a reference. Fourier transmission infrared spectroscopy were carried by FTIR-6800 is JASCO Europe Italy. Photo electro chemical properties were carried by CH instrument model CHI660C, Shanghai Chenhua Device Company, Time –Resolved Electrochemical instrument using a 450 W xenon arc lamp (Newport, USA). GC analysis was performed by gas chromatograph TCD detector (Perkin Elmer Clarus 590 GC containing molecular Sieve/5Å column) using nitrogen (N_2) as carrier gas.

Platinization Calculation:

0.25 mL of H_2PtCl_6 from 8wt % aqueous solution:

Density =mass/volume (d=m/v)

V=m/d

Mass of H_2PtCl_6 =100g(given)

Density of 1w%=1.05g/cm^3

V=100/1.05

1g of TiO_2 (1w%) is taken 10 mg,

1w% of platinum M. Wt is 195.084 g in H_2PtCl_6, M. Wt is 409.81g/mol therefore 10mg platinum =409.81x10/195.084

=21.0068mg is required for 10mg of platinum.

=95.23cm^3 this is only 1w% of H_2PtCl_6.

$$= \frac{95.23x21.0068}{8x1000}$$

=0.25ml platinum from 8w% of H_2PtCl_6.

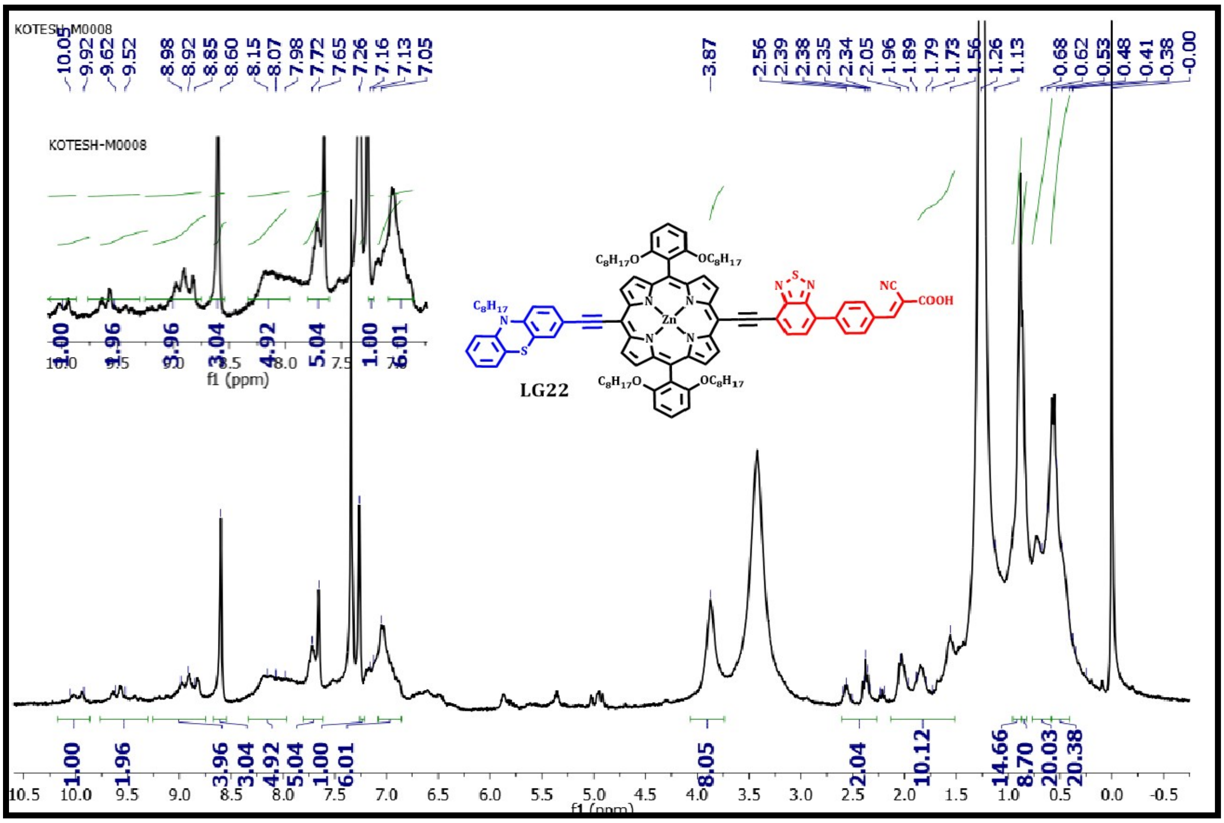

Figure S1. *^{1}H NMR spectrum (500 MHz, $CDCl_3$+ C_5D_5N) of **LG22***.

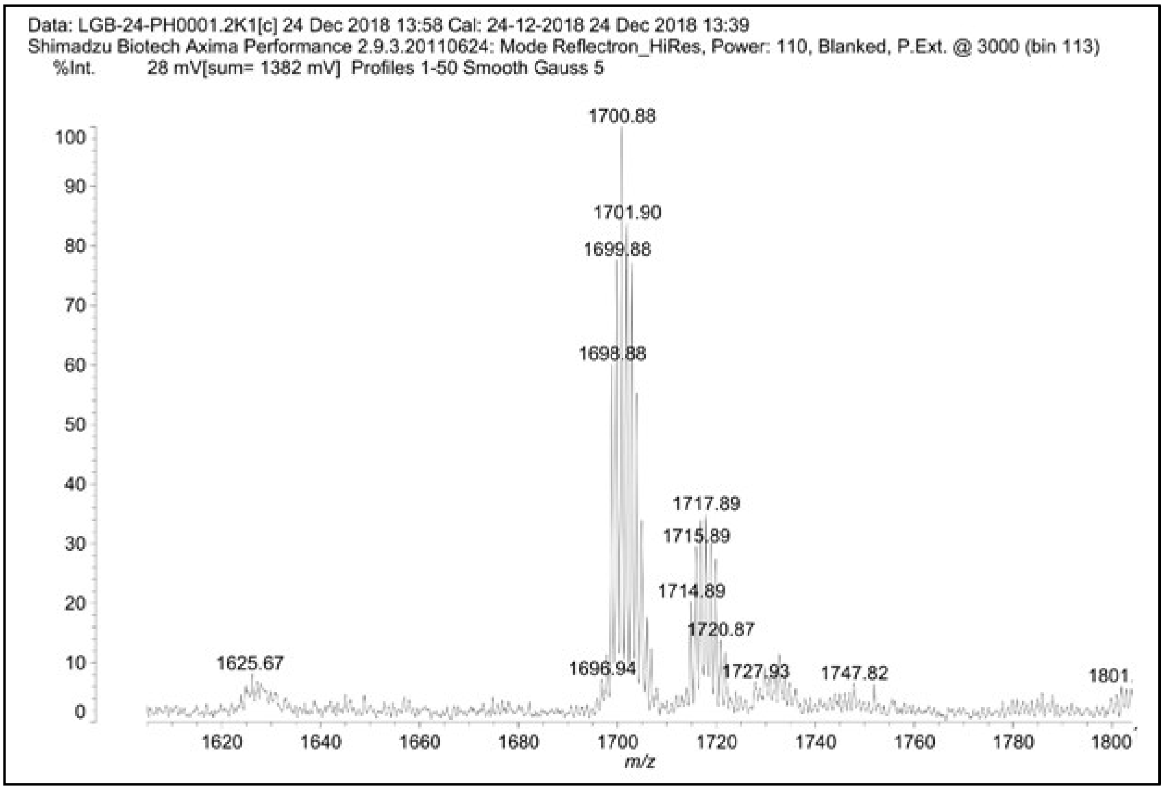

Figure S2. *MALDI-TOF of **LG22.***

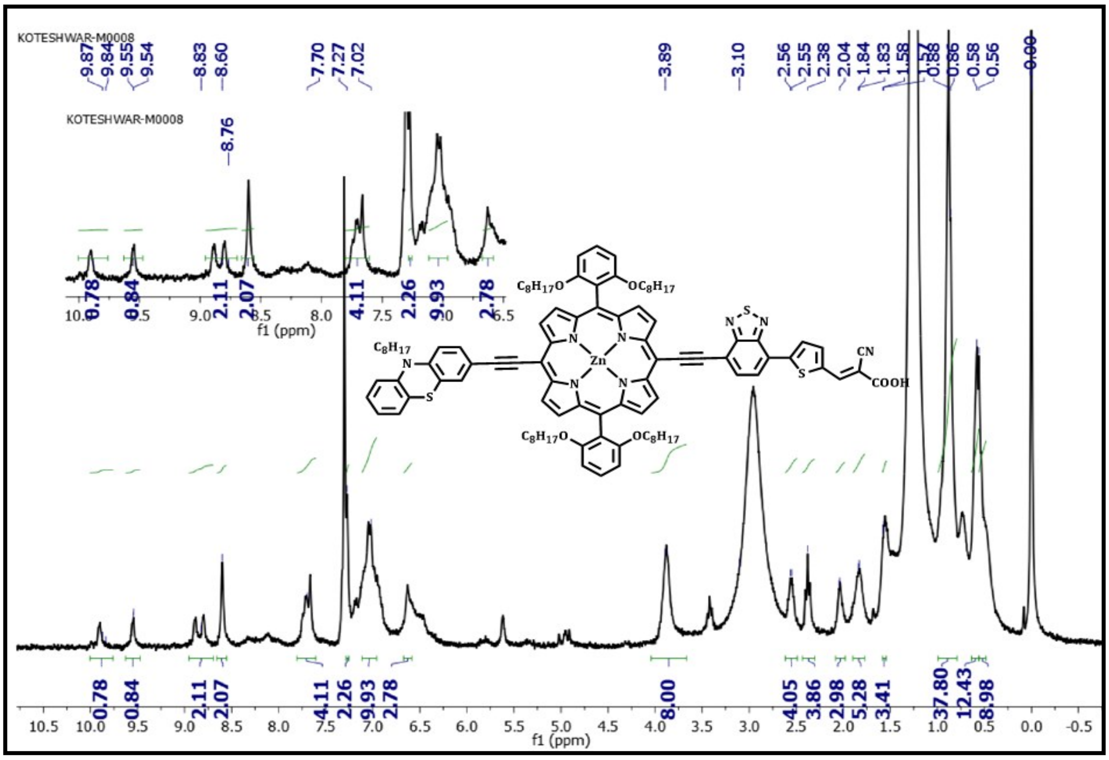

Figure S3. *[1]H NMR spectrum (500 MHz, CDCl3+ C5D5N) of LG23.*

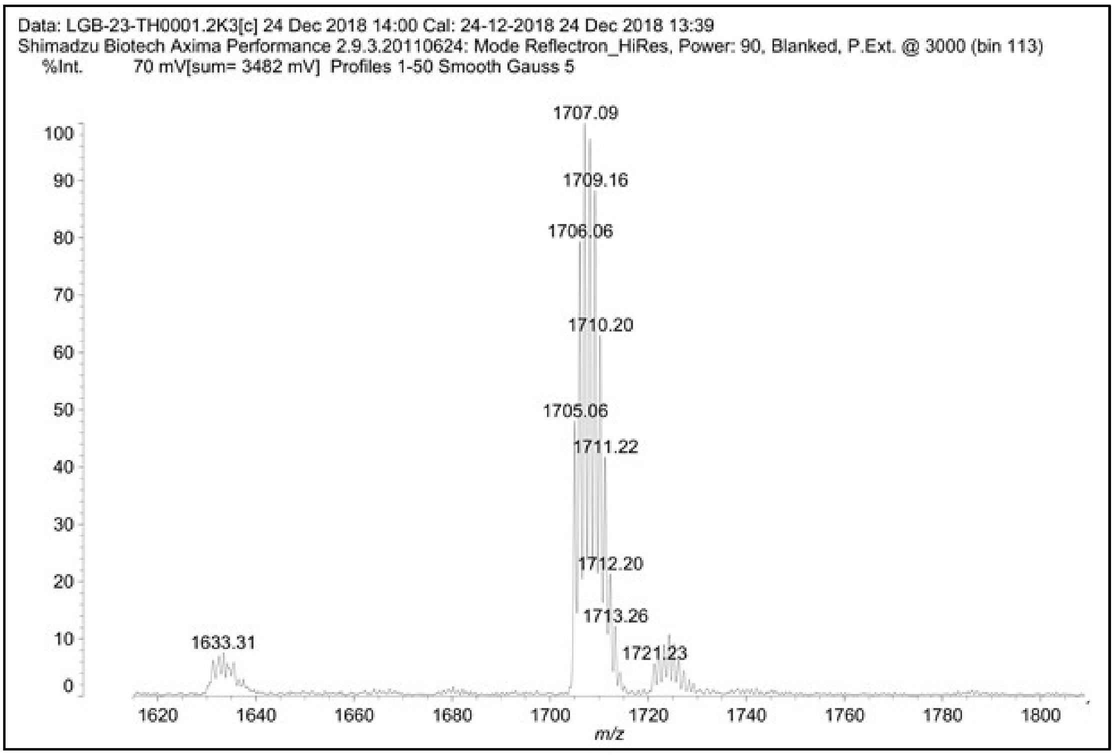

Figure S4. *MALDI-TOF of* ***LG23***

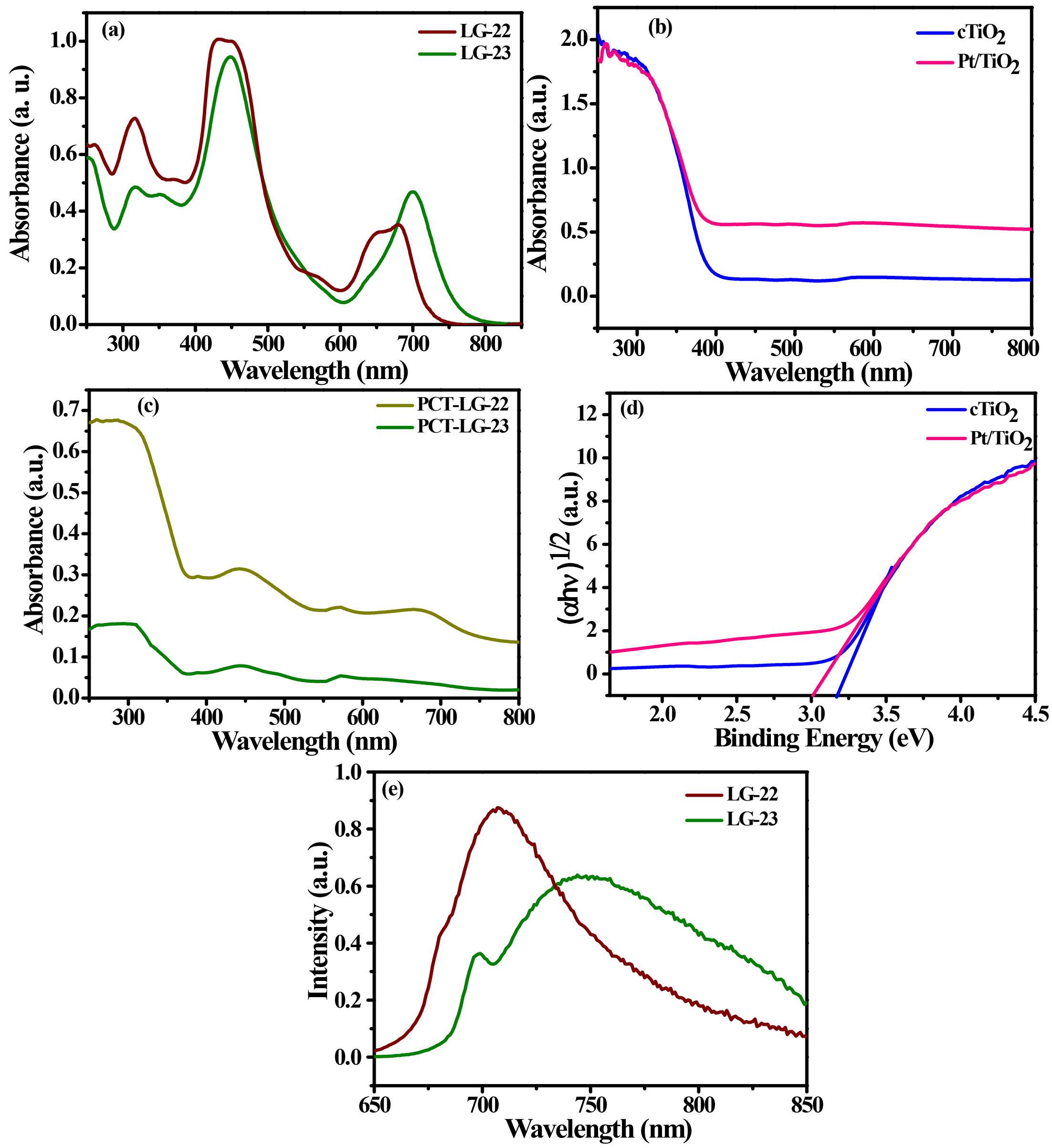

Figure S5: (a) UV-vis absorption spectra of LG-22, LG-23, UV-vis DRS of (b) $cTiO_2$ and Pt/TiO_2 (c) PCT-LG-22, PCT-LG-23, Tauc Plot of (d) $cTiO_2$, Pt/TiO_2, (e) Photoluminescence of PCT-LG-22, PCT-LG-23.

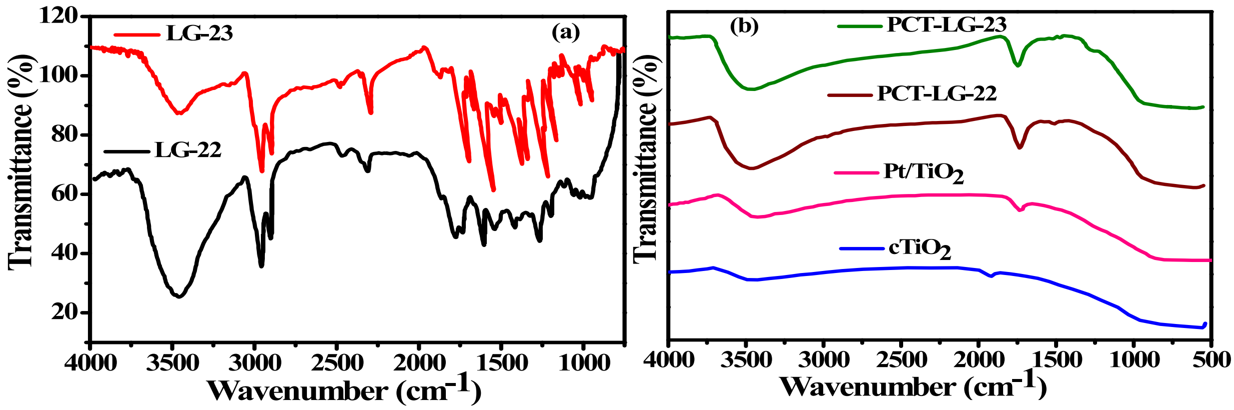

Figure. S6: FTIR analysis of (a) LG-22 and LG-23 dyes, and (b) $cTiO_2$, Pt/TiO_2, PCT-LG-22 and PCT-LG-23.

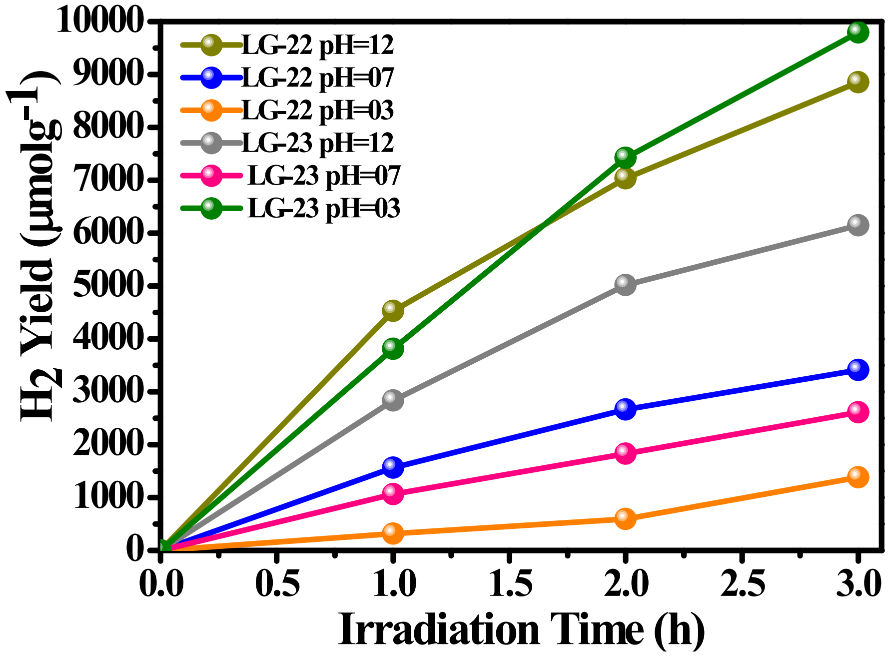

Figure. S7: Time Course for the photocatalytic hydrogen generation.

Photocatalytic Water Splitting Reaction: Hydrogen production calculation

Therefore, the TON can be calculated according to equation (1).

$$TON = \frac{\text{Number of dye molecules adsorbed}}{2 * \text{number of evolvedH2 molecules}} \qquad (1)$$

The apparent quantum yields (AQY) are calculated according to the following equation (2).

$$\text{AQY}(\%) = \frac{\text{H2 molecules of evolved} * 2}{\text{incident photons}} \ (or) \ \frac{2X\ Rate}{N} x100 \quad (2)$$

Standard area of pure hydrogen gas (H_2) = 3039348.66×mL

In atmospheric condition at normal temperature pressure (NTP)=22.4 mL

1m.mol=22.4 mL

$0.1\ mL\ (or)$ 1 m.ml Standard area of pure hydrogen gas (H_2) = 3039348.66 mL

? = x mL

$$= \frac{0.1ml \times X}{3039348.60 * 22.4} = 1.4688 \times 10^{-9} \text{m.ml} \times X$$

75 mL pyrex glass contaning empty space=55 mL due to 20 mL calalytic solution

1.4688×10^{-9}m.ml× X=1 mL

?=0.1mL

1.4688×10^{-9}m.ml/0.1mL/1mL

$=1.4688 \times 10^{-8} \times X$

$= 1.4688 \times 10^{-5}$ X m.ml

$= 0.014688 \times 10^{-3} \times$ X µ.ml

10 mg of catalyst=$0.014688 \times 10^{-3} \times$ X µ.ml

55ml empty space=?

$$H2 = \frac{0.014688x10 - 3 \times 55\ \mu.ml}{10\ mg}$$

$$= \frac{0.014688x10 - 3 \times 55\ \mu.ml\ X1000}{10\ mg}$$

=0.08078 $\mu.ml\ /g$.x X

Calculation of Number of incident proton ‘N’

$$N = \frac{E\lambda}{hc}$$

E= Nhv (according to plank equation)

$$\nu = \frac{c}{\lambda}$$

$$E = Nh\frac{c}{\lambda}$$

E=Incident light of radiation

E= $2.75x10^{-3}$joule

λ=wave length of light(420nm)

h = plank constant ($6.626x10^{-34}$js) or $6.626x10^{-27}$ erg-s

c=speed of light($3x10^{8}$m/s) or $3x10^{10}$ cm/s

Surface area of reactor=$6.5cm^2$

Irradiation time=4hours

$$N=\frac{2.75x10-3\,j\,X\,420x10-9m\,X\quad 6.5m2X4\,X3600s}{6.626x10\text{ - }34js\,X\,3x108\qquad m/s}$$

$$N=\frac{2.75x10^{-3}\ j\ x420x10^{-7}\ cm\ x6.5cm^2x4x3600s}{6.626x10^{-34}\ j\text{-}s\ x3x10^{10}cm/s}$$

N=$5.43x10^{13}$

Table S1: Comparison of photocatalytic hydrogen generation efficiency of different reported photosensitizers

Sl. No	Photocatalyst	Light Source	pH	SED	H_2 Yield	TON	AQY (%)	Reference
1	Zn-CoDETPP	300W Xe lamp	-	TEOA	43 µmol h^{-1}	-	7.36	1
2	$[ZnTMPyP]^{4+}$–MoS_2/RGO	300W Xe lamp	7		2560 µmol h^{-1} g^{-1}	-	15.2	2
3	ZnTCPP-MoS_2/TiO_2	300W Xeon-lamp equipped with a cut-off filter (λ>420 nm).	8	TEOA	10.2	261	-	3
4	YD2-o-C8	LED	4	Ascorbic Acid	47700 µmol g^{-1} h^{-1}	2370	1.22	4
5	PdTAPP-TFPT	300 W Xe lamp		sodium ascorbate	30880 µmol g^{-1}	-	0.75	5
6	Pt/THPP-Zn-TiO_2	300W Xe Lamp	-	TEOA	1239.8 µmol	-	-	6

					g^{-1} h^{-1}			
7	ZnCoDETPP	300W Xe Lamp	-	TEOA	43 µmol h^{-1}	-	7.36	7
8	2%NP/g - C_3N_4	300W Xe Lamp	-	TEOA	2297 µmol g − 1 h − 1	15	-	8
8	PHPT-LG5	450W Xe -lamp	7	TEOA	4196 µmol $g^{-1}h^{-1}$	8392	7.43	9
9	PCT-LG-DtT	450W Xe -lamp	7	TEOA	6641 µmol g^{-1} h^{-1}	13282	61.13	10
10	PCT-LG-tT	450W Xe -lamp	7	TEOA	7396 µmol g^{-1} h^{-1}	14792	54.89	10
11	**PCT-LG-22**	**Xenon-300W Lamp**	**12**	**TEOA**	**8,850.9**	**11,801.2**	**15.67**	**This work**
12	**PCT-LG-23**	**Xenon-300W Lamp**	**3**	**TEOA**	**9,793.5**	**13,058**	**17.34**	**This work**

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