Supplementary Information

A simple carbazole based sensitizer attached to nafion-coated-TiO₂ Photocatalyst:

Impact of controlling parameters towards visible light driven H₂ production

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Experimental Section:

General Information: In the present work all chemicals used were analytical grade, and were obtained from commercial sources. Importantly anatase Titanium (IV) oxide was purchased from Sigma Aldrich and used as such unless otherwise stated, Perkin–Elmer, USA; FT-IR spectra of the samples were recorded in the range of 400–4000 cm⁻¹ on a Nicolet MAGNA-IR 750 spectrometer with samples prepared as KBr pellets. ¹H NMR was carried out by Bruker Spectrometer operating at 300 MHz in methanol-d4 solvent; mass spectrum was collected by Micro mass Q-Tof Micro instrument. UV-Vis and UV-Vis Diffuse Reflectance Spectra (DRS) were recorded at ambient temperature using Cary-500 UV-Vis Spectrophotometer along with the usage of different compartment for DRS; Electrochemical measurement was done by CHI600E, CH instruments; Powder X-ray diffraction (PXRD) measurements were characterized using Bruker AXS diffractometer (D8 advance) with Cu-Ka radiation (λ = 1.5406 Å), a generator voltage of 40 kV and current 30 mA. The sample was scanned in the range of 20= 5-100° with the scan rate 1s/step. The HRTEM micrograph of the sample was prepared by taking acetone dispersion of Au-TiO₂ on the carbon coated copper grid and drying at room temperature in air followed by vacuum. HRTEM was carried by JEOL 2010EX operated at an accelerating voltage of 200 KV fitted with a CCD camera. GC analysis was performed by Perkin-Elmer gas

chromatograph Clarus-580 instrument with a thermal conductivity detector and a 5 Å molecular sieve column (2 mm \times 2 mm) using Argon as carrier gas.

Wave number (cm ⁻¹)	Assignment and comment
3400 - 3450	Stretching vibration of –OH group associated
3000-3100	Stretching vibration of carboxylic moieties and/or –CH
2800 - 2950	Asymmetric stretching vibrations of –CH ₃
2850-2950	Asymmetric stretching vibrations of –CH ₂ group from the hydrocarbon skeleton
2210 - 2250	Stretching vibration of −C≡N group
1600 -1650	Alkenyl str vibration of C–C group
1550 -1600	Stretching vibration of aromatic ring C=C-C group; Bending vibration of –NH
1350 - 1450	Stretching vibration of aromatic ring C=C-C group; Symmetric str vibration of
	COO ⁻ group
1330 - 1400	Symmetric bending vibration of –CH ₃ group
1150 - 1250	Stretching vibration of C≡N group
1050 -1150	Stretching vibration of –CO group from carboxylic acid
1050 - 1100	Bending vibrations of –C– (C=O) –C group of ketone (probable overlapping
	with stretching vibration of -CO group from secondary alcohol and/or with
	stretching vibrations of –C=O groups from the ether)
750-680	Methylene –(CH ₂)n rocking,(n=3)
675-650	Out of plane bending vibration of aromatic –C–H

Table S1 FTIR data range of dye (AM & MK2) and dye@TiO₂ composites.





Fig. S1. FTIR of (a) MK2 dye, (b) MK2@TiO₂, (c) AM dye and (d) D1@ TiO₂.



Fig. S2. ¹H NMR spectra of AM dye in CD₃OD solvent.



Fig. S3. ESI–Mass Spectra of synthesized AM dye.



Fig. S4 Energy Dispersive X-ray microanalysis (EDX) image of Nf/TiO₂.



Fig. S5 Photocatalytic activities of the (a) D1@PT and (b) D2@PT composites (with four different dye concentrations) after 6 h irradiation under visible light ($\lambda \ge 400$ nm), Conditions: 10 mg photocatalyst in 20 mL of 10 vol % aqueous TEOA (2 mL) solution, pH-7.



Fig. S6 Photocatalytic activities of the D2@PT composite at five different amounts of catalysts after 6 h irradiation under visible light ($\lambda \ge 400$ nm), Conditions: photocatalyst in 20 mL of 10 vol % aqueous TEOA (2 mL) solution, pH-7.



Fig. S7 Photocatalytic activities of the D2@PT composite (TiO₂ calcined at different temperatures) after 6 h irradiation under visible light ($\lambda \ge 400$ nm), Conditions: photocatalyst in 20 mL of 10 vol % aqueous TEOA (2 mL) solution, pH-7.



Fig. S8 Cyclic H₂-evolution curve for the AM@NPT