Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A


# Manipulating Solar Absorption and Electron Transport Properties of Rutile $TiO_2$ Photocatalyst via Highly n-Type F-Doping

**Wen Qi Fang,[a,b] Xue Lu Wang,[a,c] Haimin Zhang,[c] Yi Jia,[b] Ziyang Huo,[b] Zhen Li,[d] Huijun Zhao,[c] Hua Gui Yang*[a,c] and Xiangdong Yao*[b]**

[a] *Key Laboratory for Ultrafine Materials of Ministry of Education, School of Materials Science and Engineering, East China University of Science and Technology, 130 Meilong Road, Shanghai 200237, China.*

[b] *QLD Micro- and Nanotechnology Centre, Griffith University, Nathan Campus, QLD 4111, Australia.*

[c] *Centre for Clean Environment and Energy, Griffith School of Environment, Griffith University, Gold Coast Campus, QLD 4222, Australia*

[d] *Institute for Superconducting & Electronic Materials (ISEM), University of Wollongong, Innovation Campus, NSW, 2500, Australia*

*Corresponding authors:* E-mail: x.yao@griffith.edu.au (X. Yao) Fax: +61 73735 7773; Tel: +61 73735 3782;

E-mail: hgyang@ecust.edu.cn (H. G. Yang) Fax: +86 21 64252127; Tel: +86 21 64252127

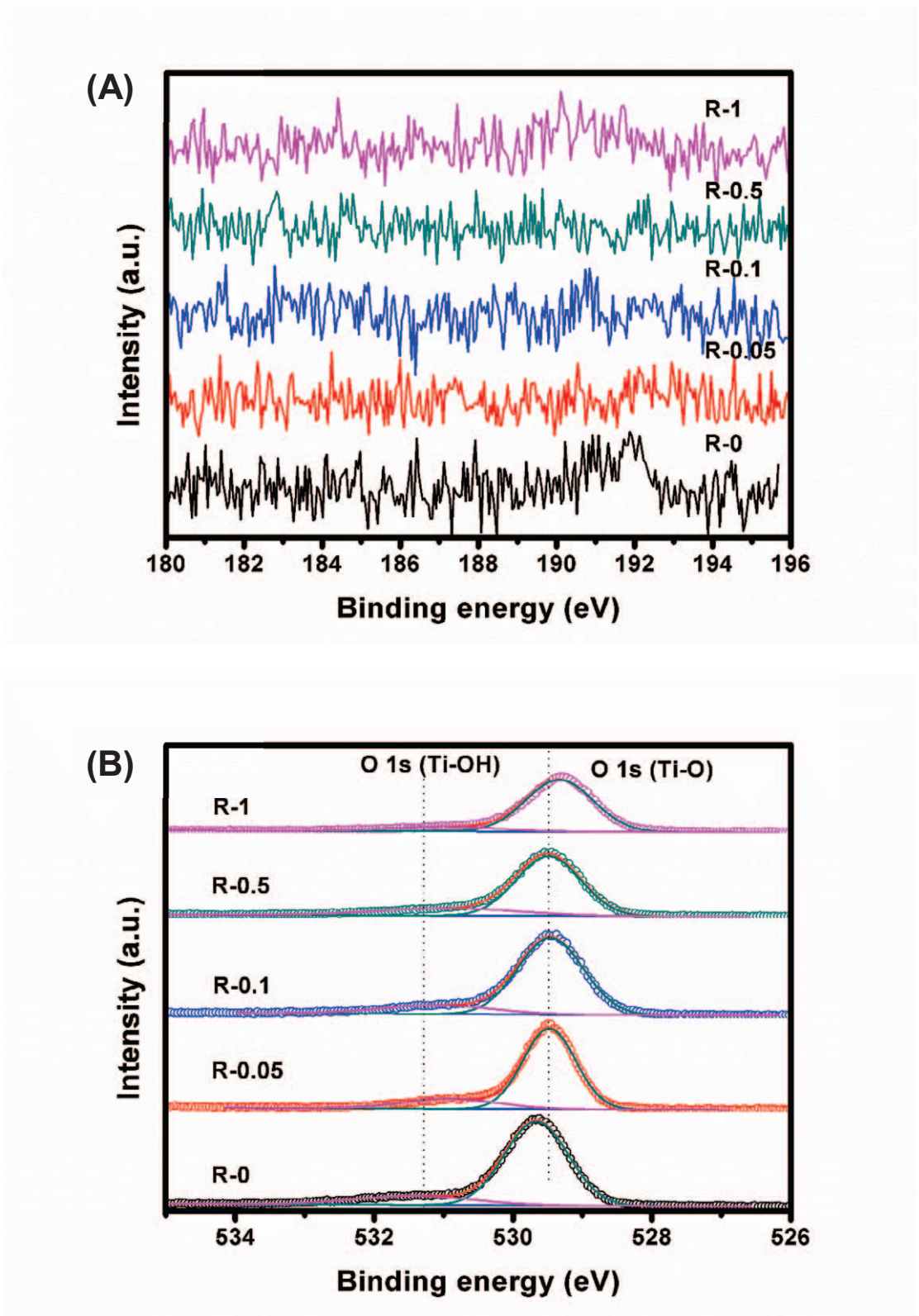


**Fig. S1** XPS spectra of (A) B 1s and (B) O 1s from the rutile single crystal $TiO_2$ with different F:Ti molar ratios of reaction precursors.

The photoconversion efficiencies of pristine and F-doped $TiO_2$ films were calculated using the equation

$$\eta = I(1.23-V)/J_{light}$$

where V is the applied bias vs RHE, I is the photocurrent density at the measured bias and $J_{light}$ is the irradiance intensity of 100 $mW/cm^2$. The calculated photoconversion efficiency as a function of the applied bias are show in Fig. S2B

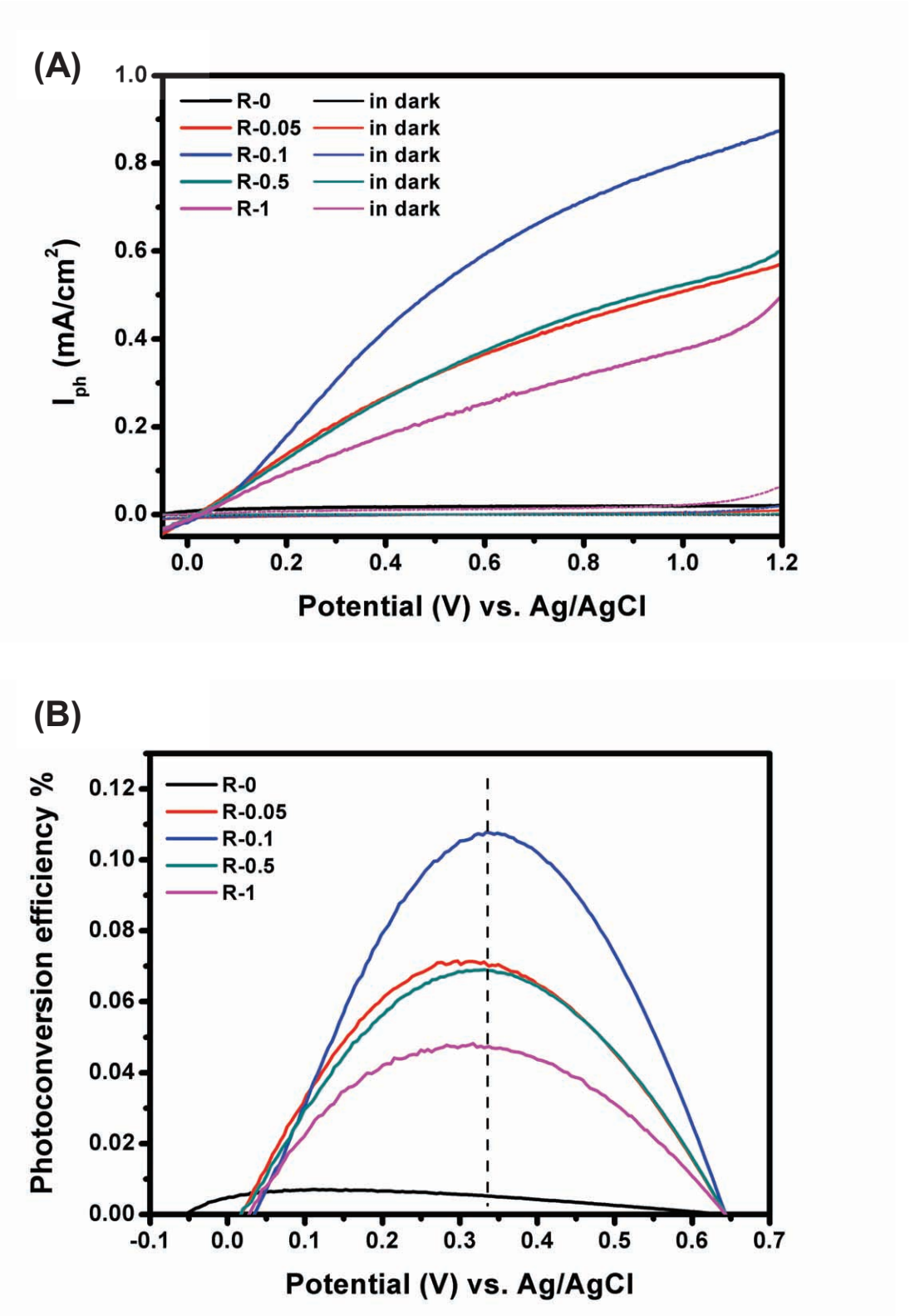


**Fig. S2** (A) Photoelectrochemical (PEC) cell linear sweep voltammetry spectra of the pristine $TiO_2$ (R-0) and F-doped (R-0.05 to R-1) $TiO_2$ films in a 0.2 M $Na_2SO_4$ solution with a scan rate of 20 mV/s under 100 mW/cm$^2$ illumination. (B) Calculated photoconversion efficiencies for the pristine $TiO_2$ (R-0) and F-doped (R-0.05 to R-1) $TiO_2$ samples, as a function of applied potential vs Ag/AgCl.

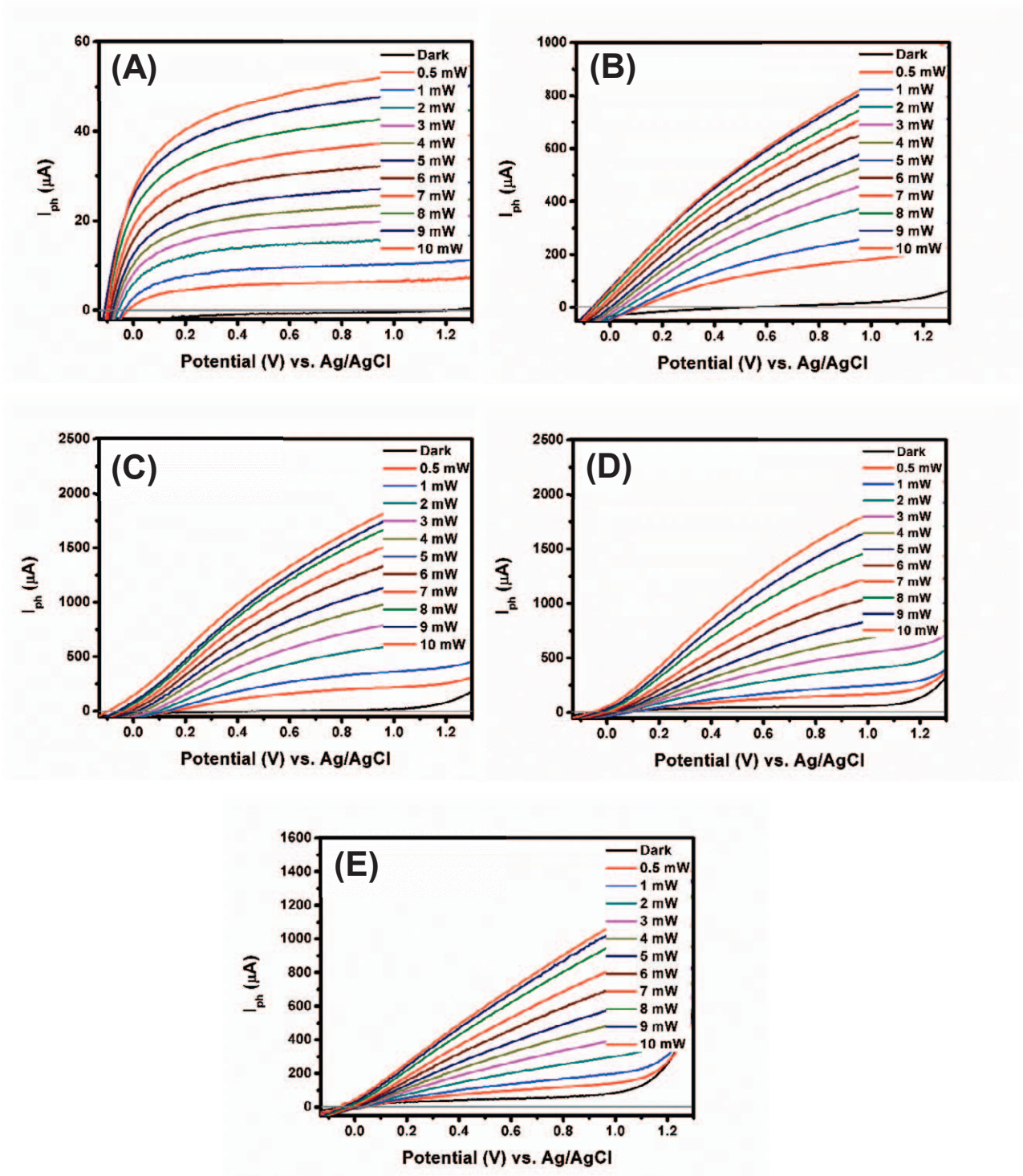


**Fig. S3** Photoelectrochemical (PEC) cell linear sweep voltammetry spectra obtained from the rutile $TiO_2$ photoanodes with different initial F:Ti molar ratios of (A) 0:1, (B) 0.05:1, (C) 0.1:1, (D) 0.5:1 and (E) 1:1 in 0.2 M $Na_2SO_4$ supporting electrolyte, under different UV light intensities.

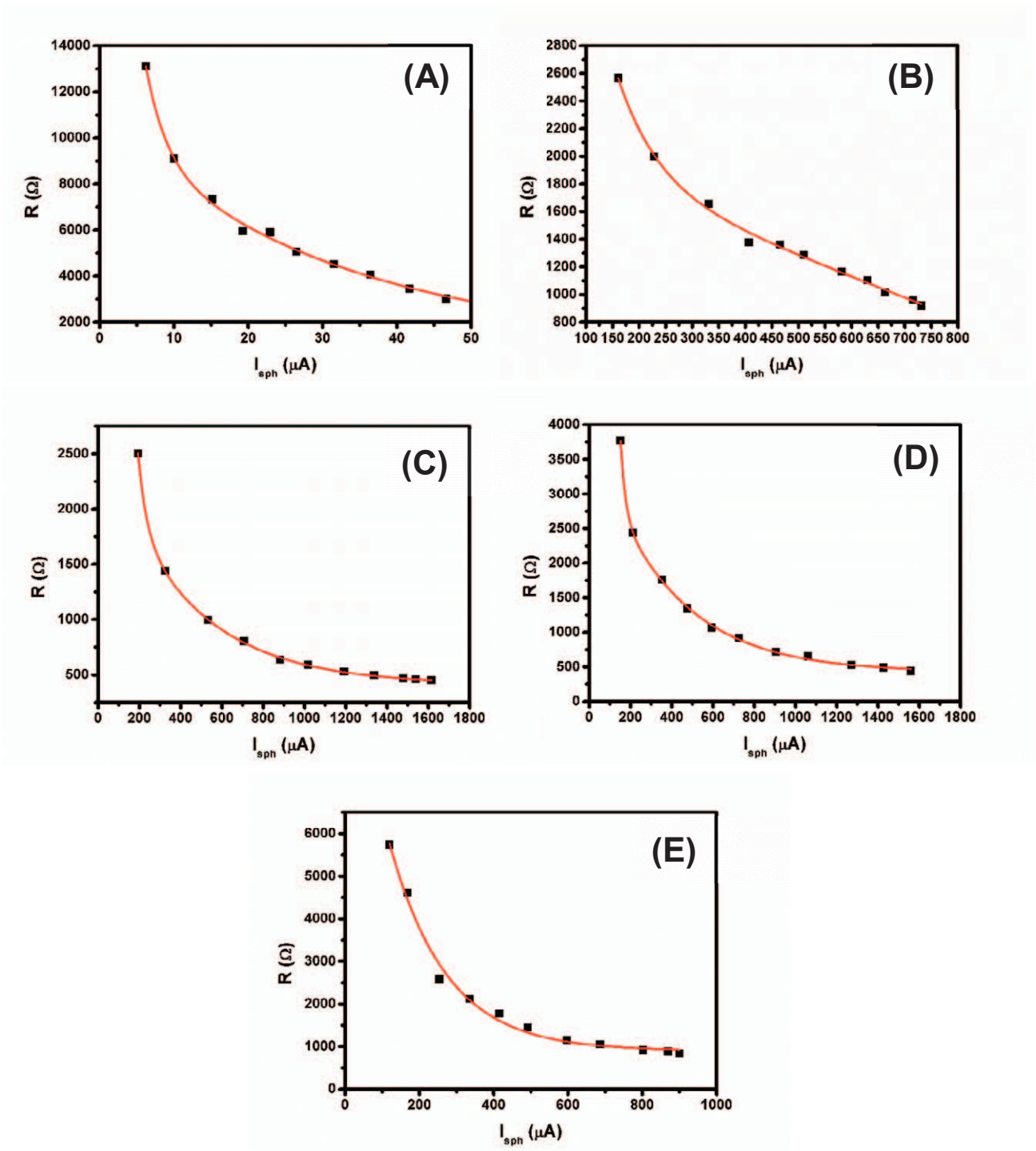


**Fig. S4** Relationships between the measured resistance and saturation photocurrent obtained from the rutile $TiO_2$ photoanodes with different initial F:Ti molar ratios of (A) 0:1, (B) 0.05:1, (C) 0.1:1, (D) 0.5:1 and (E) 1:1 in 0.2 M $Na_2SO_4$ supporting electrolyte, under different UV light intensities.

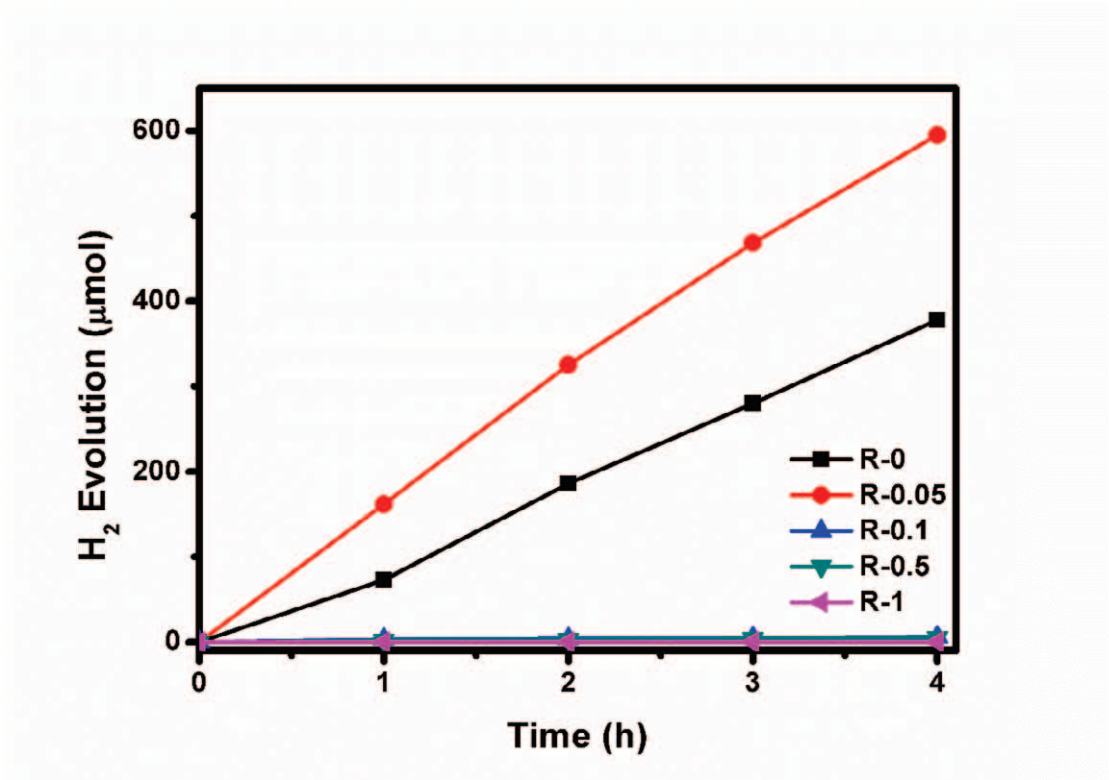


**Fig. S5** Time course of evolved $H_2$ of F-doped $TiO_2$ samples from water containing 10 vol% methanol as an electron donor under UV-vis light irradiation.