Supporting Information

Slightly hydrogenated TiO$_2$ with enhanced photocatalytic performance

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**Figure S1.** XRD patterns of the pristine-TiO$_2$ and H-TiO$_2$ prepared by H$_2$ plasma treatment after different times of 30 s, 1 min, 3 min, 5 min, and 20 min.
Figure S2. XPS O 1s core level spectrum of the pristine-TiO$_2$ and H-TiO$_2$ prepared by H$_2$ plasma treatment after different times of 30 s, 1 min, 3 min, 5 min, and 20 min.

Figure S3. XPS valence band spectra of the pristine-TiO$_2$ and H-TiO$_2$ prepared by H$_2$ plasma treatment after different times of 30 s, 1 min, 3 min, 5 min, and 20 min.
Figure S4. The experimental and simulated bulk Ti$^{3+}$ signal of H-TiO$_2$-20min, and the simulated subsurface Ti$^{3+}$ signal of H-TiO$_2$-1min without light irradiation, the relative amount of Ti$^{3+}$ was appraised through the double integration of the resonance lines: $S_1$ and $S_2$ represented as signal 1 and 2, respectively; $IS_1$ and $IS_2$ represented as the integration of the signal 1 and 2, respectively (EPR absorption spectra); $DIS_1$ and $DIS_2$ represented as the double integration of the signal 1 and 2, respectively (green and red area in EPR absorption spectra).
Figure S5. Photocatalytic degradation of methylene blue (InCt/C versus irradiation time) over pristine-TiO2 and H-TiO2 prepared by H2 plasma treatment after different times of 30 s, 1 min, 3 min, 5 min, and 20 min and their calculated reaction rates (k).

Figure S6. EPR analysis of H-TiO2-20min: “dark spectra” represented as the spectra recorded without light irradiation; “523 nm light-excited spectra” represented as the spectra recorded under 523 nm irradiation; “405 nm light-excited spectra” represented as the spectra recorded under 405 nm irradiation; “523 nm light-induced EPR spectra”
represented as the spectra recorded under 523 nm irradiation subtracted by that of the spectra without light irradiation ("523 nm light-excited spectra" - "dark spectra"); “405 nm light-induced EPR spectra” represented as the spectra recorded under 405 nm irradiation subtracted by that of the spectra without light irradiation ("405 nm light-excited spectra" - "dark spectra"). “CuL$_2$” represented as the hyperfine structure lines of the Cu$^{2+}$(DTC)$_2$ complex in benzene solution, which has been used as the correct g factors of studied paramagnetic centre determination (low field maximum amplitude of $m_l=-1/2$ hfs line attributed to $g=2.025$).

**Figure S7.** The experimental and simulated light-induced EPR spectra of prisine-TiO$_2$ under 405 nm light irradiation, the relative amount of Ti$^{3+}$ and O$^-$ were appraised through the double integration of the resonance lines: $S_1$ and $S_2$ represented as signal 1 and 2, respectively; IS$_1$ and IS$_2$ represented as the integration of the signal 1 and 2, respectively (EPR absorption spectra); DIS$_1$ and DIS$_2$ represented as the double integration of the signal 1 and 2, respectively (green and red area in EPR absorption spectra).