Supporting Information of

Photo-induced re-modulation of Pt particles loaded on V-TiO_2 for enhanced CO photocatalytic oxidation

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1. Materials synthesis

Synthesis of V-TiO_2: TiO_2 (P25, Evonik Degussa) was from commercial sources. Typically, 0.2 g TiO_2 was degassed in vacuum (6×10^{-2} Pa) at 200 ^oC for 5.0 h with a heating rate of 10 ^oC/min. The as-obtained sample gave light grey color and was donated as V-TiO_2. Academically, V-TiO_2 is rich in Ov sites in its surface lattice.

Synthesis of Pt/V-TiO_2 and Pt/TiO_2: Pt/V-TiO_2 photocatalysts was prepared by a photo-reduction method. 0.1 g of V-TiO_2 was mixed with 5.3 mL of H_2PtCl_6 solution (1.0 g/L) followed by the addition of 100 mL of methanol/H_2O solution (volume ratio: methanol/H_2O=1/4). The suspension was magnetically stirred for 3.0 h under UV illumination (a 300 W high-pressure Hg lamp, Shanghai Yaming Light). After irradiation, the samples were centrifuged, washed and then dried at 60 ^oC under vacuum overnight to obtain Pt/V-TiO_2 (nominal Pt content: 0.2 wt%).

Similarly, Pt/TiO_2 (nominal Pt content: 0.2 wt%) composite was prepared when using TiO_2 instead of V-TiO_2 in the above procedure.

2. **Material characterization**

The crystalline phase of powders was examined by powder X-ray diffraction (XRD) using an X-ray diffractometer (Rigaku Ultima IV) operating in the reflection mode with Cu K_a radiation. UV-vis spectrophotometer (Shimadzu UV-2600) was used to analyze the UV-vis diffuse reflectance spectra (DRS) of samples to observe their optical properties. High resolution transmission electron microscopy (HRTEM) was investigated using a JEOL JEM 2100F instrument operated at 200 kV. To prepare the HRTEM specimens, the powder samples were first dispersed ultrasonically in absolute ethanol in a centrifuge tube for nearly 10 min. After standing for 10 min, one drop of the supernatant suspension was dropped onto a carbon film supported copper grid and allowed to dry in air before the specimen was transferred into the microscope. CO Chemisorption was measured with a pulse method on AutoChem II 2920 (Micromeritics). The sample was first reduced with H_2 at 200 ^oC for 1 h and then cooled to room temperature in flowing He to ensure that all Pt species were transformed into Pt^0 (CO chemsorbed with Pt^0 in stoichiometric ration of $CO/Pt_{surf}=1$). Several pulsed of CO were the introduced into the sample until no more adsorption was observed. The instrument employed for X-ray photoelectron spectroscopy (XPS) studies was a Thermo Fisher ESCALAB 250Xi system with Al K_α radiation (photon energy 1361 eV), and calibrated internally by C1s binding energy (BE) at 284.6 eV from the carbon contaminants. Electron paramagnetic resonance (EPR) spectra were collected on an EMX-8/2.7C spectrometer (Bruker, Germany) while the catalyst powders (20 mg) were placed in EPR capillaries to prepare the sample. All EPR spectra of the catalysts were obtained at room temperature under ambient condition. Raman measurements were performed at room temperature using Raman spectrometer (Reinshaw invia) with the excitation wavelength of 532 nm.

3. **Photocatalytic performance test**

The photocatalytic oxidation of CO was employed to probe the activities of different catalyst samples. The photocatalytic oxidation processes of CO were carried out in a closed loop gas-flow system at ambient temperature and pressure. The photocatalytic reactor was made of a horizontal quartz tube with a flange connection. The reactor was connected to a circulation pump through an external Teflon tubing (o.d. 0.32 cm) to push the gas in the system in dynamic loop. A quartz plate loaded the assigned catalyst (5.0 cm × 10.0 cm× 0.2 cm) was horizontally laid into the tube for photocatalytic use. A 35 W metal halide lamp (Philips, HID-CV 35/SCDM) was fixed 10 cm right above the photocatalytic reactor. The UV light intensity on the surface of the photocatalyst is measured as 3.8 mW/cm^2. The CO concentration variation during the reactionwas real-time determined by a gas chromatograph (GC2014, Shimadzu) using FID detector and 5A molecular sieve packed column. The closed system was prefilled by pure dry air (99.9995%) and then a desired amount of CO was injected into the system to reach a concentration of 1000 ppmv. When the concentration of CO in the system reached equilibrium, the photocatalytic reaction was initiated by turning on the light.

4. **Dark reaction.**

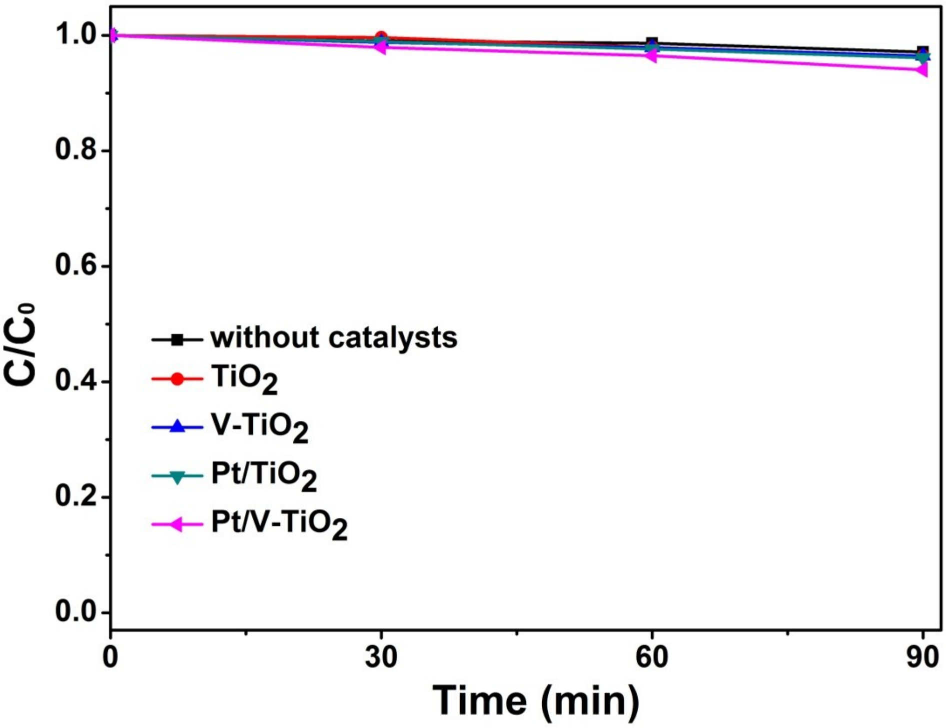

Fig. S1. The concentration variations of CO with or without catalyst in the dark.

5. **XRD patterns of the photocatalysts.**

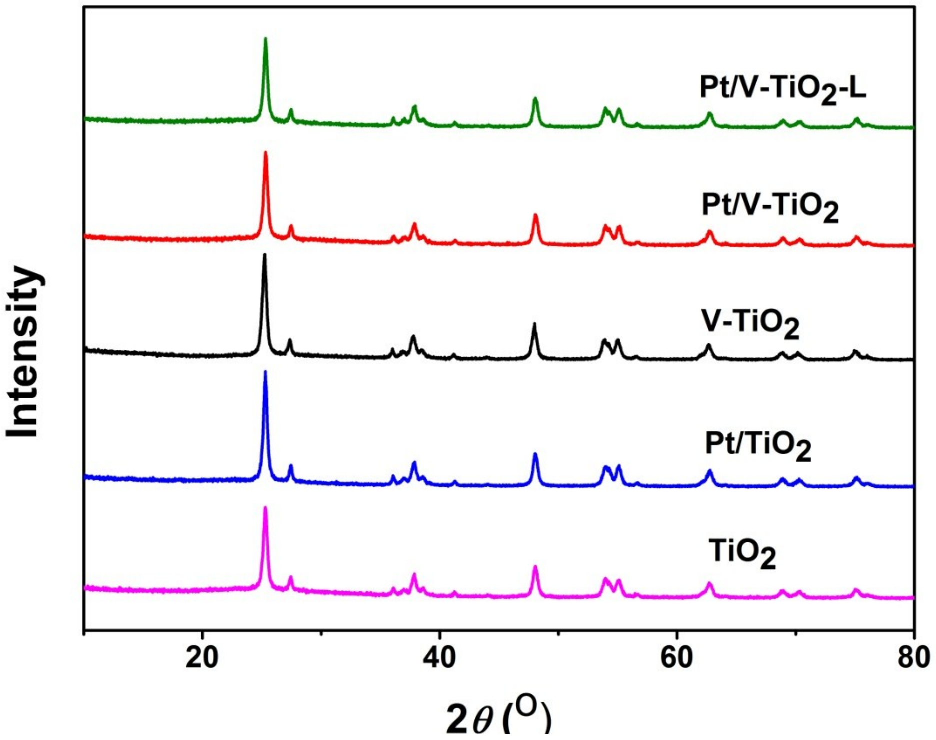

Fig. S2. XRD patterns of TiO_2, Pt/TiO_2, V-TiO_2, Pt/V-TiO_2 and Pt/V-TiO_2-L.

6. Pt particle size determination with HRTEM.

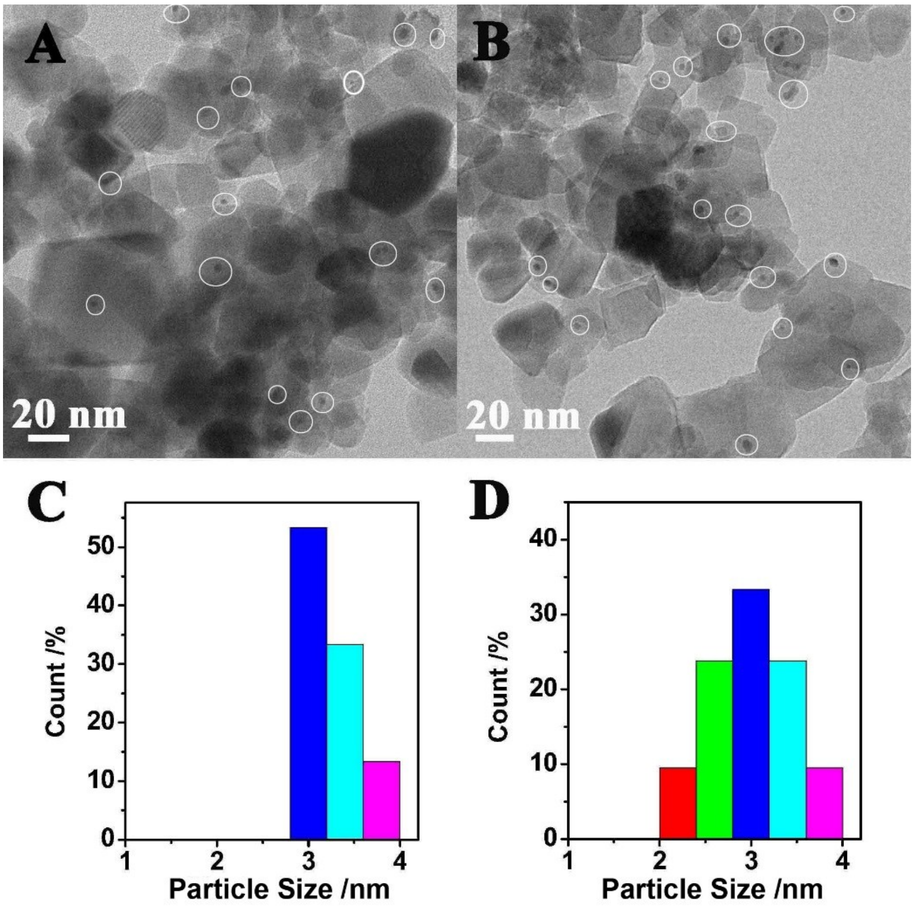

Fig. S3. HRTEM images of A) Pt/TiO_2 and B) *Pt/TiO_2-L; diameter statistics of the Pt particles for C) Pt/TiO_2 and D) Pt/TiO_2-L. * Pt/TiO_2-L refers to the Pt/V-TiO_2 sample experienced 360 min photocatalytic reaction (4 cycles).

7. Pt dispersion observation with CO chemisorption measurement.

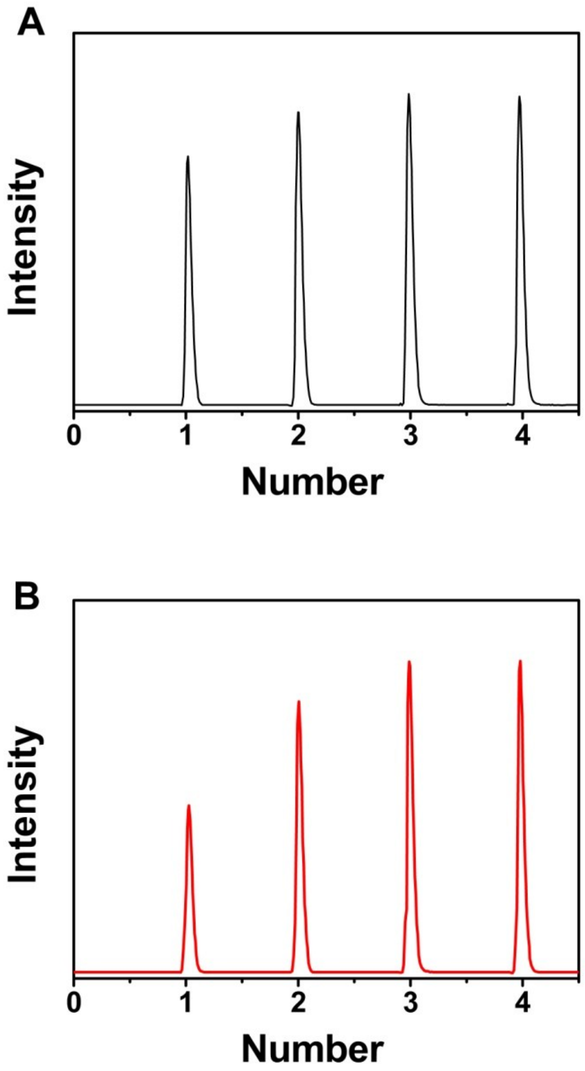

Fig. S4. CO chemisorption of (A) Pt/V-TiO_2, and (B) Pt/V-TiO_2-L.

8. **EPR Spectrum of Pt/V-TiO_2.**

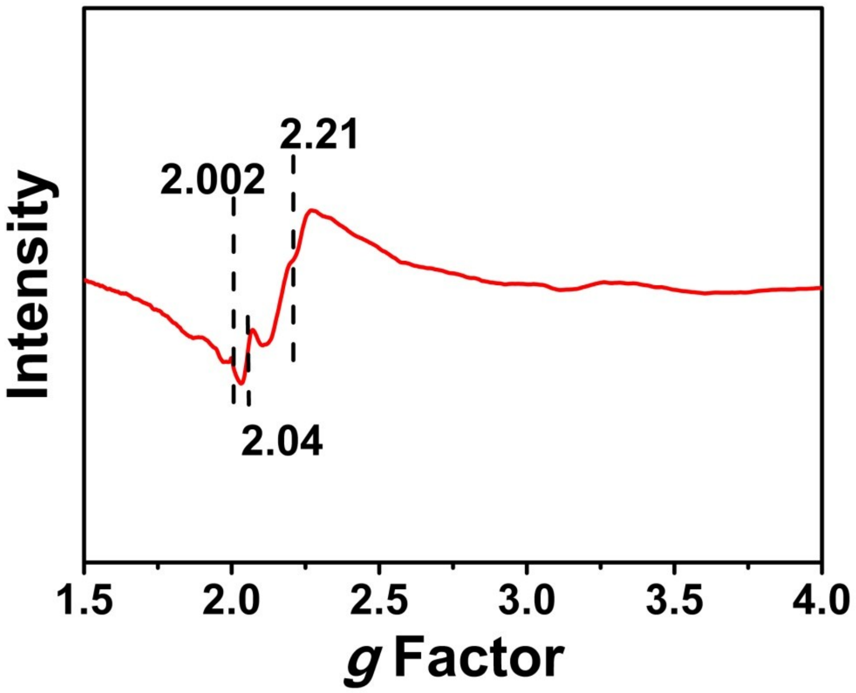

Fig. S5. EPR spectrum of Pt/V-TiO_2 after storing in the dark for two weeks

9. **Raman spectra of photocatalysts.**

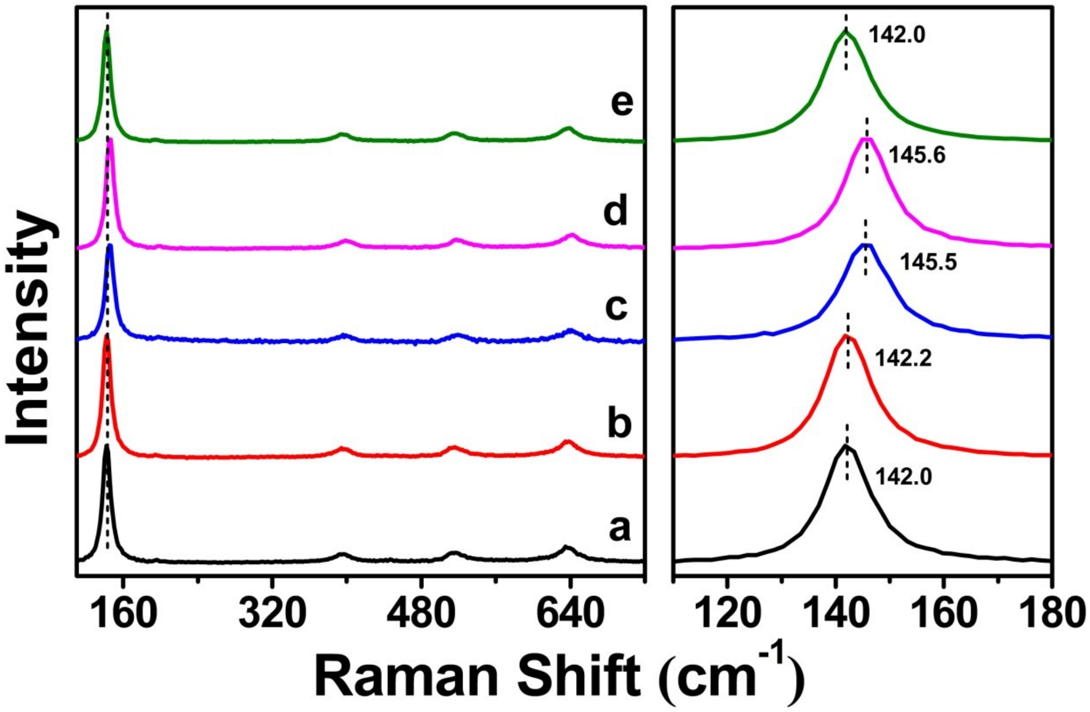

Fig. S6. Raman spectra of (a) TiO_2, (b) Pt/TiO_2, (c) V-TiO_2, (d) Pt/V-TiO_2 and (e) Pt/V-TiO_2-L

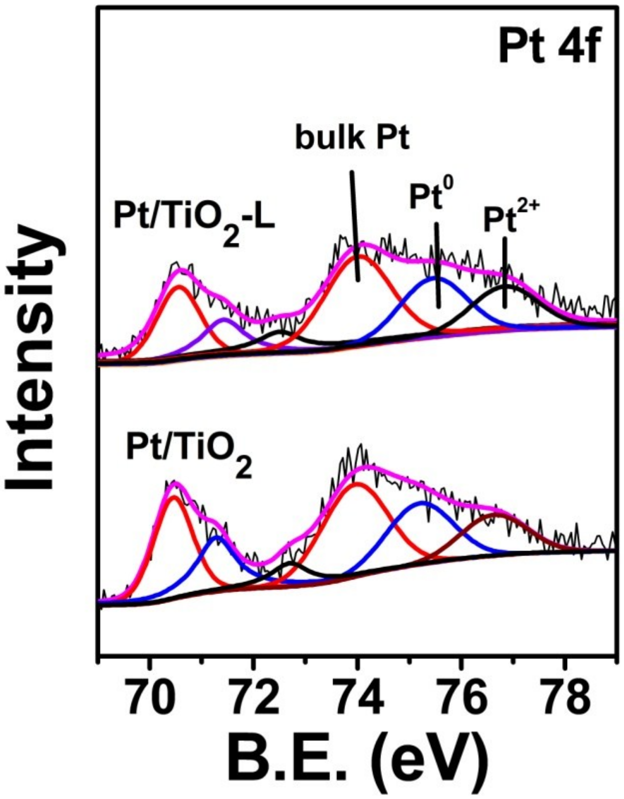

Fig. S7. Pt4f fine XPS spectra of Pt/TiO$_2$ and Pt/TiO$_2$-L.

Table S1. The influence of light-treatment on the percentage of Pt species (from XPS) before and after photocatalytic reaction.

	Pt4f core levels (%)		
catalysts	Bulk Pt	Pt^0	Pt^{2+}
Pt/TiO_2	47.5	31.4	21.1
Pt/TiO_2 -L	46.4	30.8	22.8
$Pt/V\text{-}TiO_2$	46.9	20.0	33.1
$Pt/V\text{-}TiO_2$-L	41.3	35.2	23.1