

Supplementary Information

Table SI-1 Dyes and their suppliers

Dye	Supplier
Gentian violet (GV)	Tianjin No.3 Chemical Reagent Factory
Methyl violet (MV)	Shanghai Specimen & Model Factory
Methylthionine chloride (MC)	Tianjin Chemical Reagent Research Institute
Rhodamine B (RB)	Tianjin No.3 Chemical Reagent Factory
Phenol red (PR)	Shize Biotechnology Co., Ltd., Shanghai
Fuchsin (FS)	Guangzhou Chemical Reagent Factory.
R alizarin yellow (RAY)	Beijing Chemical Reagent Research Institute
Thiazol yellow (TY)	Lee Yi Fine Chemicals Co., Ltd., Beijing
Malachite green (MG)	Chong-jun Biotechnology Co., Ltd., Shanghai
Diphenyl carbazide (DC)	Shanghai No.3 Reagent Factory
Safranin T (ST)	SSS Reagent Co., LTD, Shanghai
Thymol blue (TB)	Kaiyang Biotechnology Co., Ltd., Shanghai
Bromothymol blue (BTB)	Beijing Chemical Reagent Research Institute
neutral red (NR)	Shanghai Xinzhong Chemical Factory Co., Ltd.
Bipseudoindoxyl (BSD)	Shanghai Jinshan Xingta Meixing Chemical Factory
Fluorescein (FRS)	Shanghai No.3 Reagent Factory

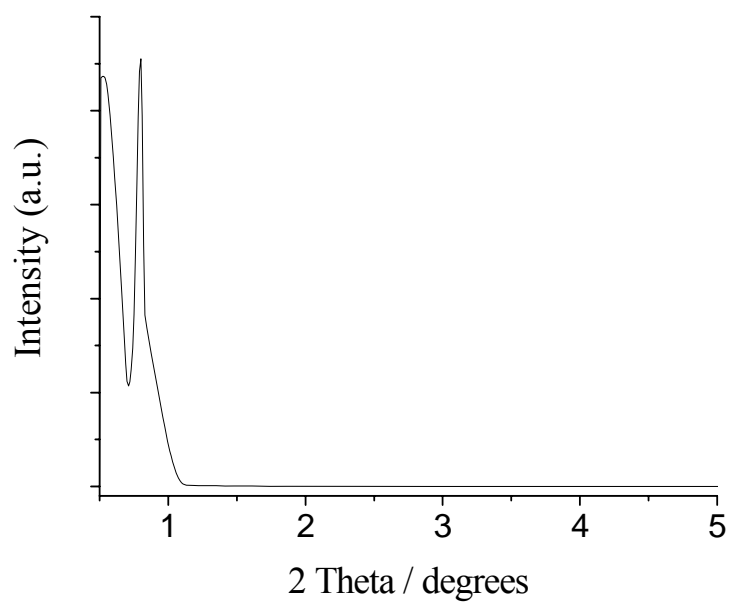


Fig. SI-1 XRD patterns of the MTiO₂/FRS

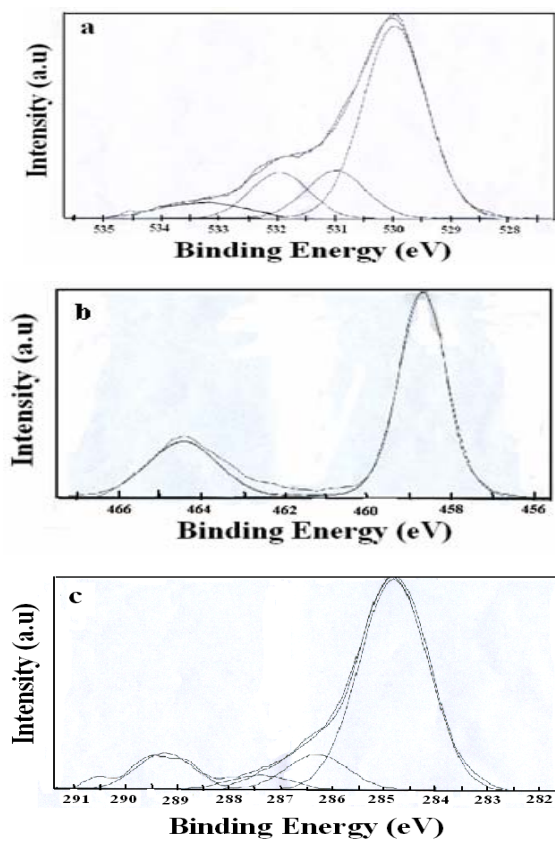


Fig. SI-2 High-resolution XPS spectra of the (a) O 1s and (b) Ti 2p and (c) C 1s regions for the MTiO₂/FRS.

Time-resolved IR absorption spectrometer: The electron decay phenomena were recorded on the Nicolet 8700 FTIR spectrometer with the InSb detector (25MHz, 1850-7400 cm^{-1}), detailed experimental design see Fig. SI-3. This instrument provides a step scan time-resolved measurement mode. In the step scan time-resolved FTIR experiments, the AC output (25 MHz to 110 Hz) of the MCT was

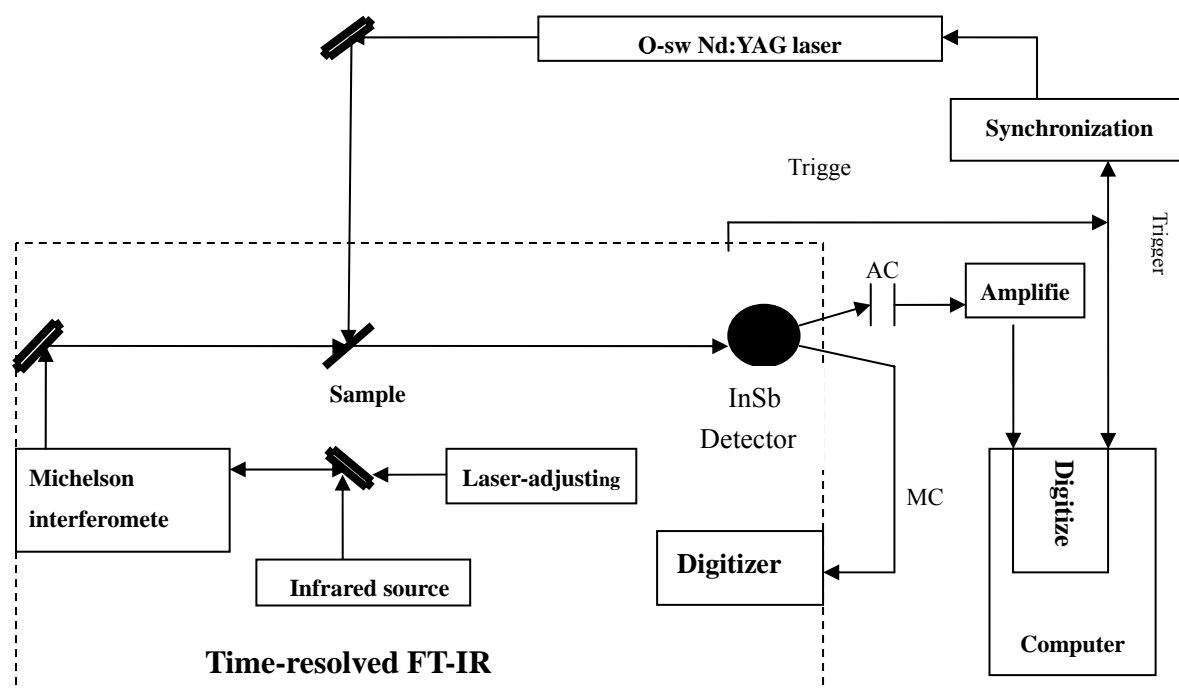


Fig. SI-3 Diagram of the time-resolved IR spectrometer for kinetic measurements on photocatalysts.

used to measure the transient signal changes. The DC output (25 MHz to 0 Hz) of the detector preamplifier was recorded the static interferogram. The AC output, further amplified by a factor of 50 with a SR560 preamplifier (Stanford Research Systems, 1 MHz-0.03 Hz) and accumulated with a 50 MHz, 20-bit A/D converter

supplied with the spectrometer as a function of delay time at a different wavenumber. The temporal profiles were reconstructed to transient IR absorption spectra at different delay times. The sample was photoexcited by 355 nm light of 10 ns pulse width from third harmonic generation of a Q-switched Nd:YAG laser (Labeit Beijing). The pulse frequency and energy were 10 Hz and 4 mJ. The synchronization between laser excitation and data acquisition was achieved with a pulse generator (made by Labeit Beijing). The instrument operation and data acquisition were all controlled by Nicolet Omnic 7.1 software package.

The transient absorption of photogenerated electrons in the three photocatalysts are shown in Fig. SI-4. The fast decay within 10 μs is mainly due to the recombination of the electrons with the holes and the minor part of the absorbance that decays slowly

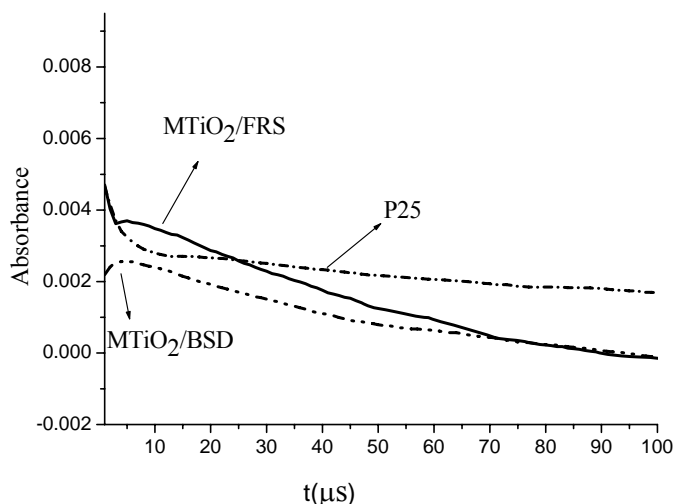


Fig. SI-4 Comparison of the decay of the transient absorption at 2084 cm^{-1} under atmosphere. Excitation wavelength was 355 nm.

corresponds to the long-lived electrons. Comparing the catalysts P25, the long-lived

electron decay of MTiO₂/FRS which has the carbonaceous species transferred from dye templates (evidenced in Section 3.4 and 3.5) was much faster. The tendency of electron decay observed in this condition is dominated by intrinsic, bulk properties of the catalysts.¹ Once the holes are captured by surface hydroxyl groups, an equal number of the electrons become the long-lived electrons because the subsequent recombination of electrons with the holes captured by hydroxyls is very slow.² MTiO₂/FRS was much faster than P25 due to the catalyst surface structure changed by carbonaceous species which reduced the number of surface hydroxyl groups and promoted the decay of electron.

On the other hand, the number of photogenerated charge carriers presented initially in a particle and mobility of the excited charge carriers possibly affects the rate of recombination.³ So, the long-lived electron decay of MTiO₂/FRS was also faster than that of MTiO₂/BSD. Therefore, there are some relationship between the long-live electron and the photocatalytic activity. However, many other factors may affect the reactivity. Further study is in progress to examine the reaction-dependent transient kinetics of the trapped electrons.

references

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