Electronic Supplementary Material (ESI) for RSC Advances.

Supplementary information

Hydrogen Titanium Oxide Hydrate: Excellent Performance on Degradation of Methyl Blue in Aqueous Solutions

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Supplementary Information

Experimental procedures and characterization data for all hydrogen titanium oxide hydrate catalysts.

Experimental:

The details of the PVP and MB dyes:

MB and PVP is chemical pure reagents (Fig. S1). As one knows, methyl blue (MB, Fig. S2) is one of the triphenylmethane acid dyes, which can be used as a fluorescent probe, biological staining agent and pH indicator. Potassium bromide used in FT-IR measurement is a spectrum pure reagent.

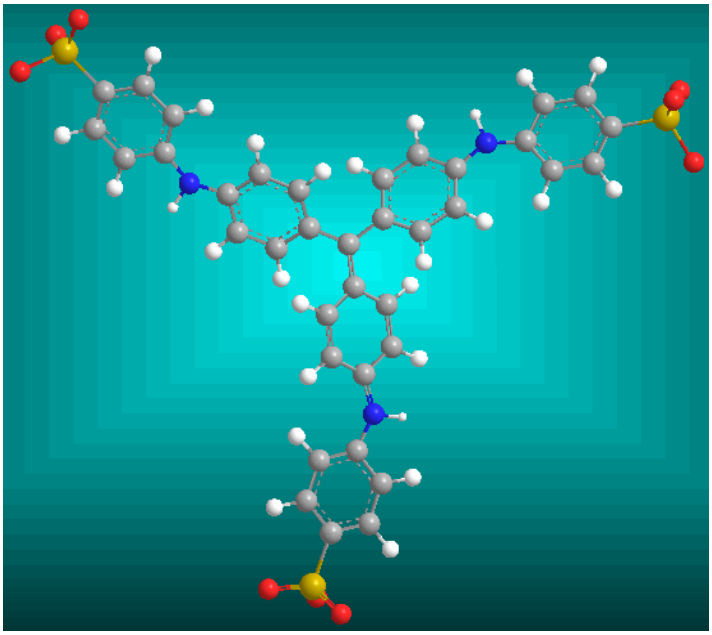


Figure S1 Chemical structures of MB and PVP.

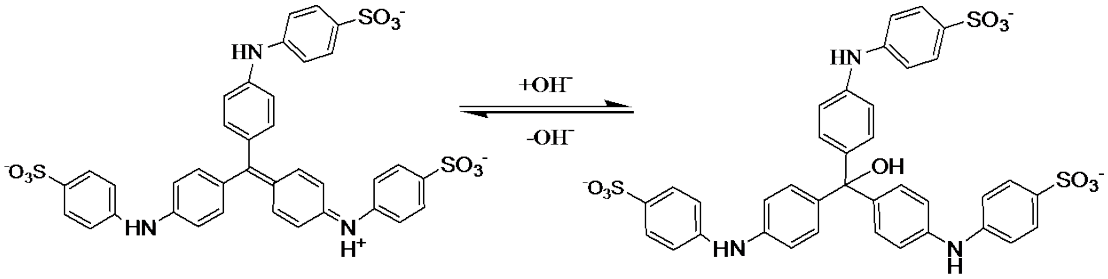


Figure S2 Equilibrium of acidic form and basic form of MB.

Preparation

Different amounts of PVP were added (0.4 g, 0.8g, 1.2 g, 1.6 g PVP to prepare samples S2, S3, S4 and S5, respectively.

Other Results

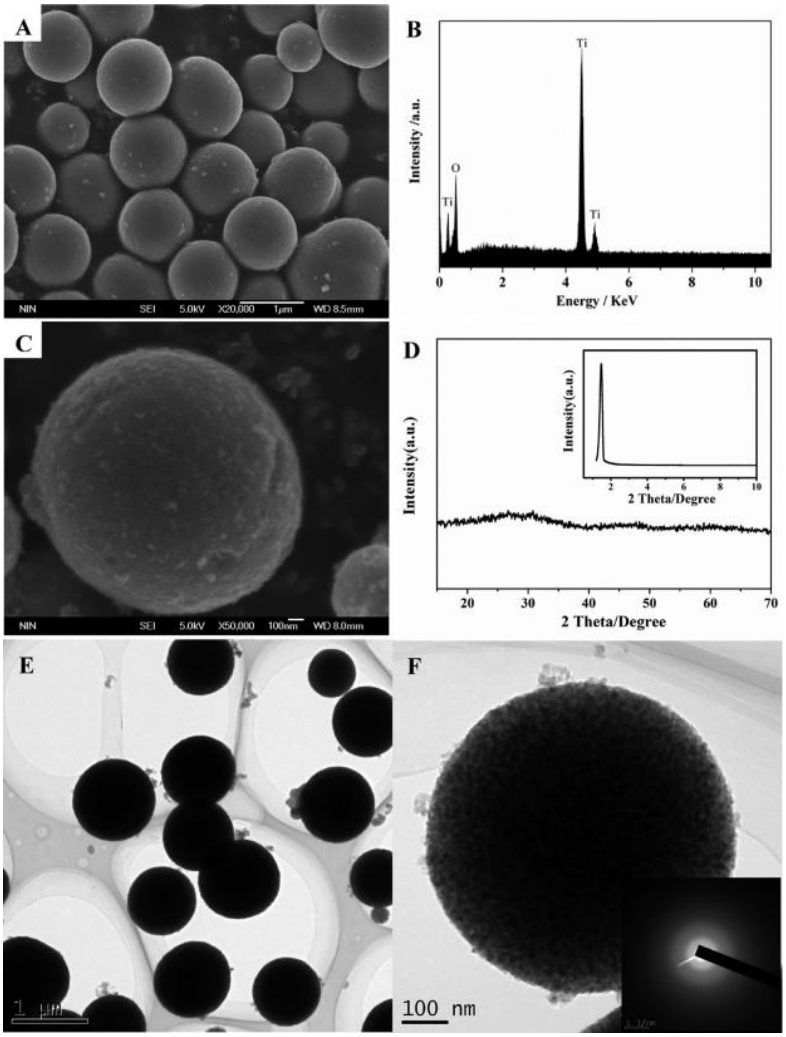


Figure S3 Physicochemical features of the TiO_2 precursor microspheres. A and C: SEM images; B: EDS spectrum; D: XRD pattern; E and F TEM images and typical SAED pattern (inset of F).

Physicochemical features of the precursors composed of monodispersed microspheres with a diameter of about 800 nm are shown in Figure 2 in our resent research work (ACS Appl. Mater. Interfaces, 2012, 4, 6816-6826). It can be observed that these microspheres are composed of many nano-particles as shown in Figures S3A and C and possess relatively smooth surfaces. Figure S3B is an EDS spectrum of the TiO_2 microspheres, which only shows elements of O and Ti, that is to say, only Ti and O elements exist in the microspheres. The phase constitution and crystallite size of the samples were

determined by X-ray diffractometry analysis using nickel filtered copper radiation (Cu Kα) at 30 kV, 30 mA over a 2θ range of 15°-70°. Figure S3D shows the XRD pattern of the precursor microspheres, indicating that these precursor microspheres are amorphous. Morphologies of the as-prepared samples were further observed by TEM and shown in Figures S3E and F, it can be clearly seen that the average diameter of the microspheres is about 800 nm and the microspheres are composed of the nanoparticles, which further confirms the results obtained by SEM. SAED pattern as an inset of Figure S3F shows that the TiO_2 precursor is an amorphous TiO_2 and without any crystal phases can be observed, which corresponds to the XRD results and also confirms that the precursor microspheres are amorphous.

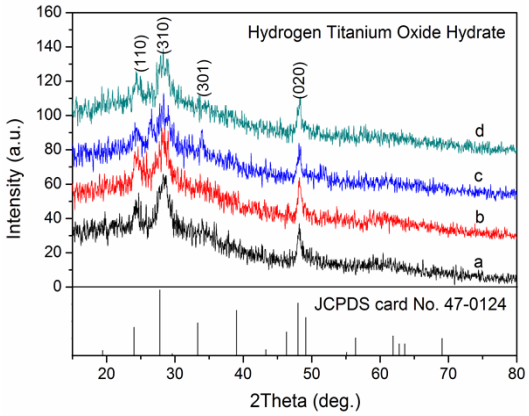


Figure S4 XRD patterns of the hydrogen titanium oxide hydrate catalysts: a, S1; b, S2; c, S3; d, S4; e, S5.

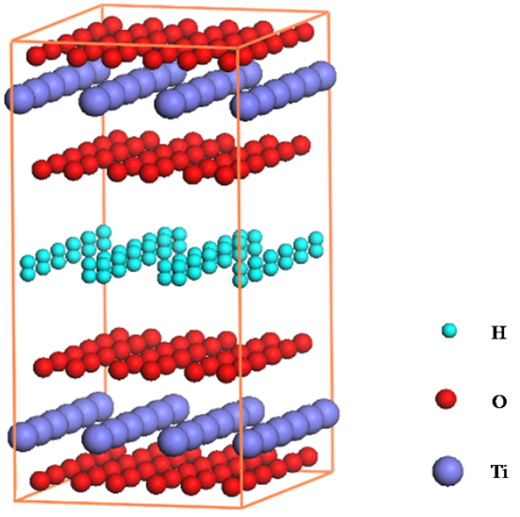


Figure S5 Three dimensional representation of the structure for hydrogen titanium oxide hydrate catalysts

The synthesized products were performed by X-ray diffractometry (D/max-2200, Rigaku, Japan) using

Cu Kα radiation (λ = 1.54 Å). Figure S4 shows the typical powder XRD patterns and Figure S5 is three dimensional representation of the structure of the products. The diffraction patterns were indexed as an orthorhombic structure $\{H_2Ti_2O_4(OH)_2\}$ with lattice parameters a = 19.26 Å, b = 3.78 Å, and c = 3.00 Å. All diffraction lines are broad and weak peaks in intensity, which correspond to (110), (600), (301), (501), (020) crystal planes, respectively (JCPDS card 47-0124).

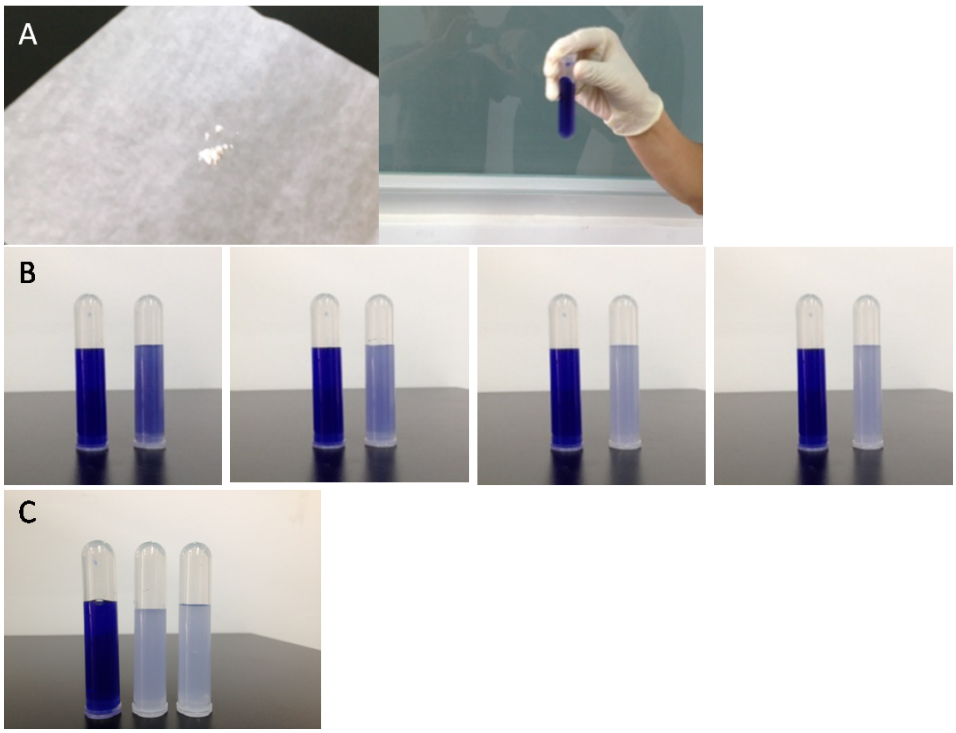
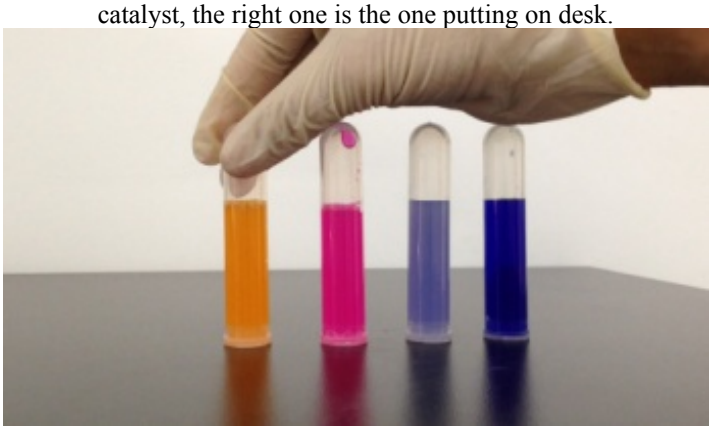
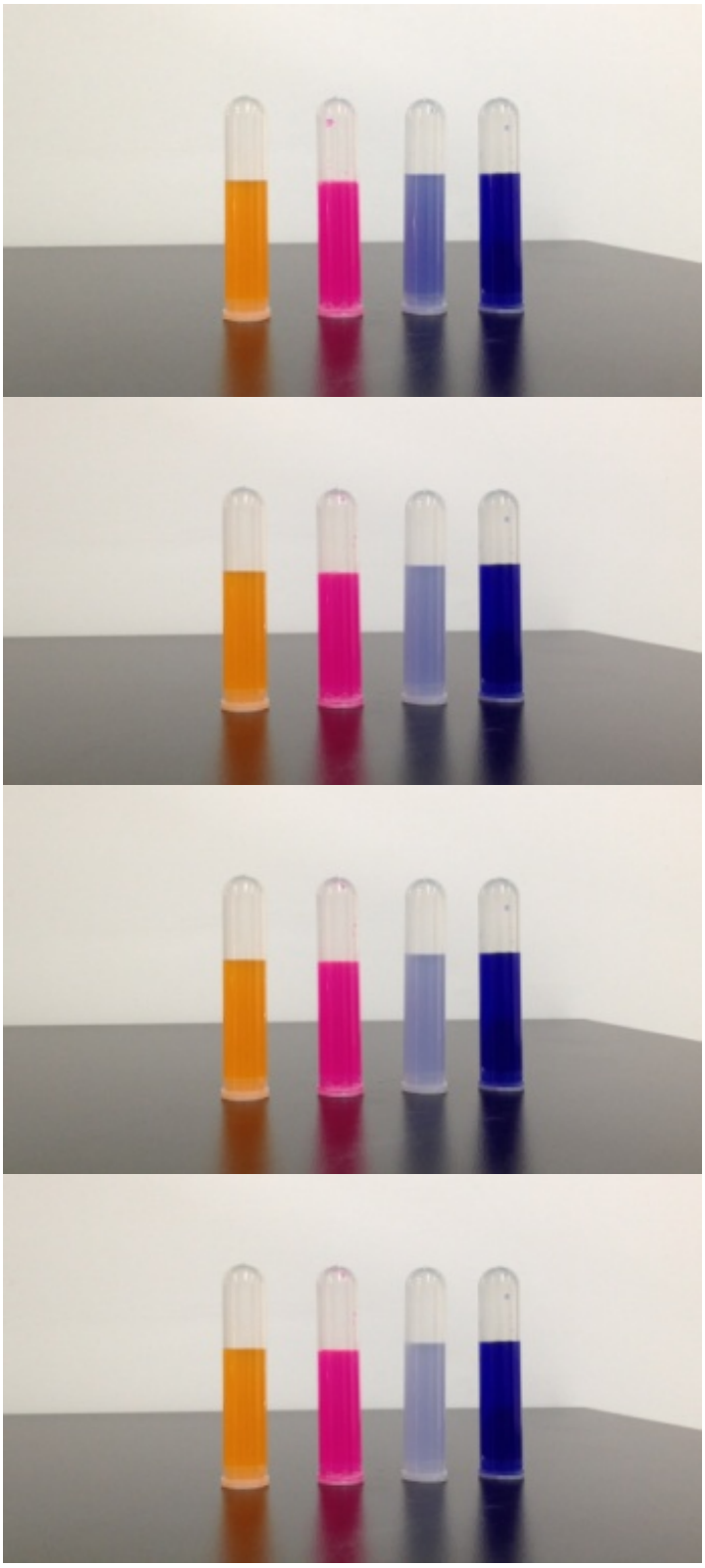


Figure S6 Photo images of the degradation process of MB. In row B, the left one is MB solution without catalyst in every figure, the right one is the one putting on desk after added catalyst and the photos were taken every 2min;
In the last row, the middle one is the one putting in dark box for 8 min after added catalyst, the right one is the one putting on desk.





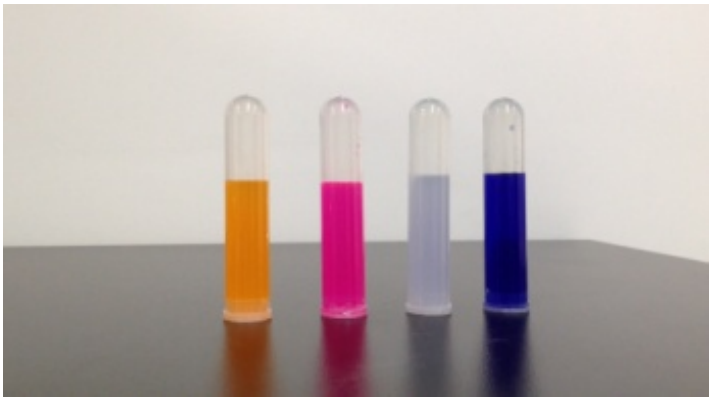


Figure S7 Photo images of the degradation process of MO(1st), RhB(2nd), MB(3rd). the 4th one is MB solution without catalyst and the photos were taken every 2min;