

Rapid and morphology controlled synthesis of anionic S-doped TiO₂ photocatalysts for visible-light-driven photodegradation of organic pollutants

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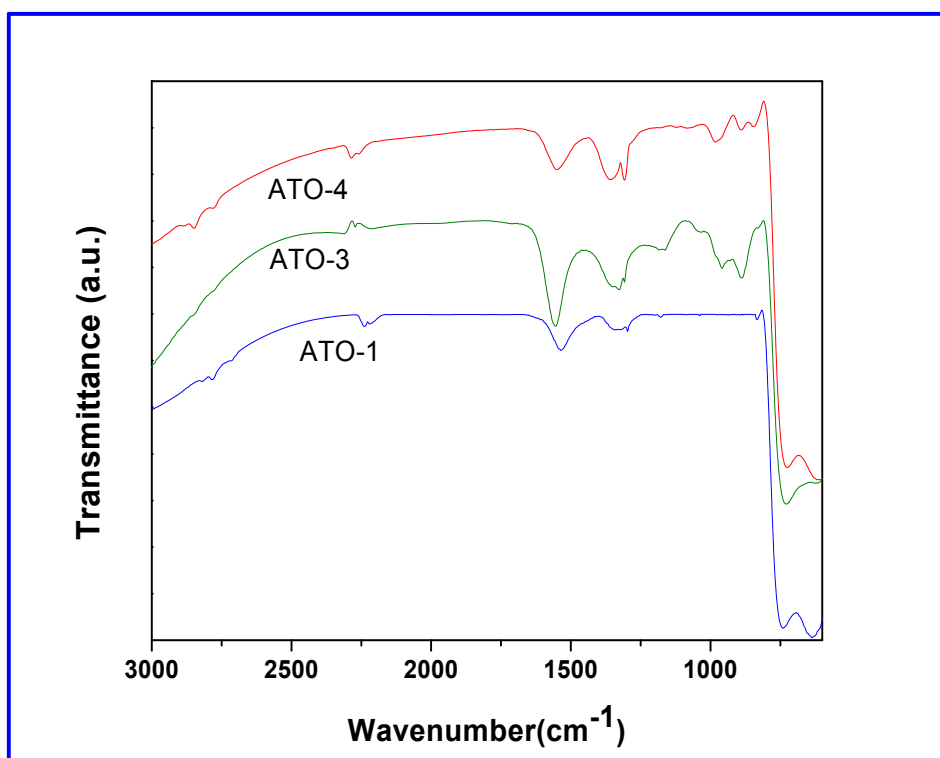


Figure 1S FT-IR spectra of pristine and S-doped TiO₂ nanorods with different S-doping concentration.

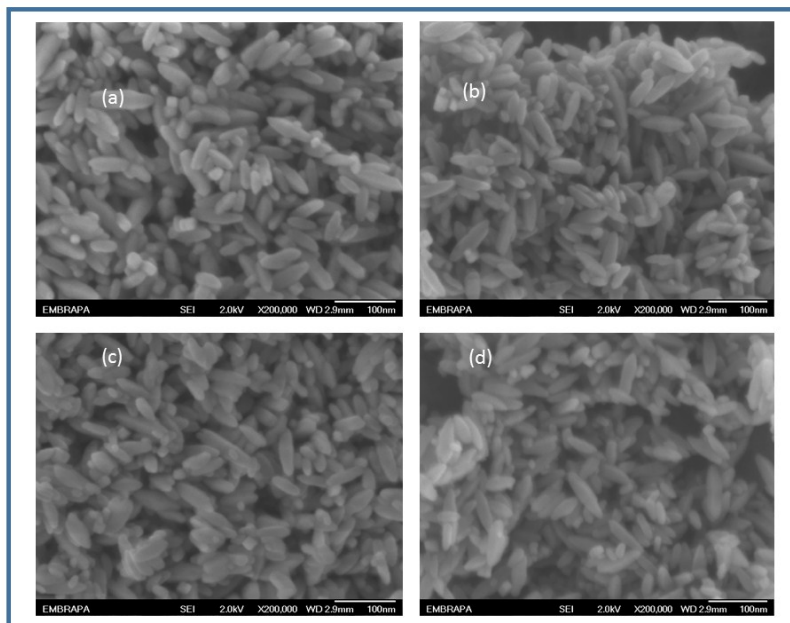


Figure 2S FE-SEM images of pristine (a) and S-doped TiO₂ nanorods (b), (c) & (d).

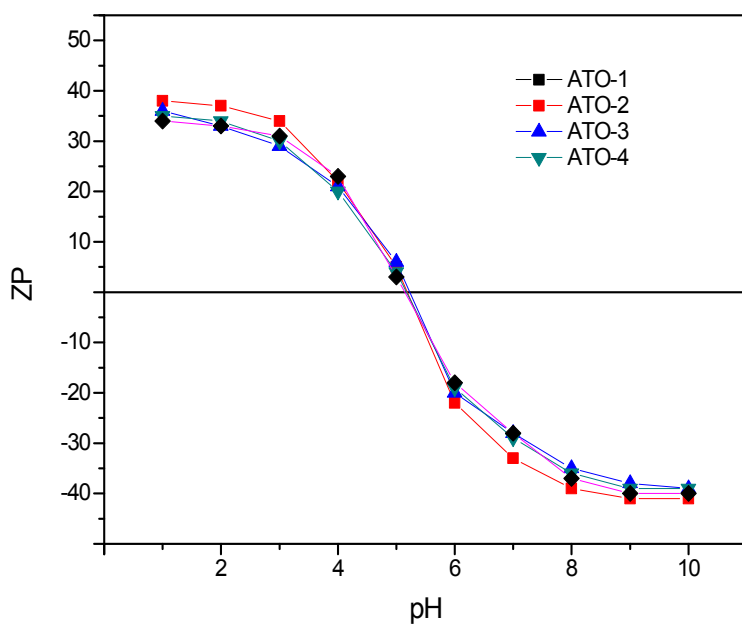


Figure 3S zeta potential plot of pristine and S-doped TiO₂ nanorods

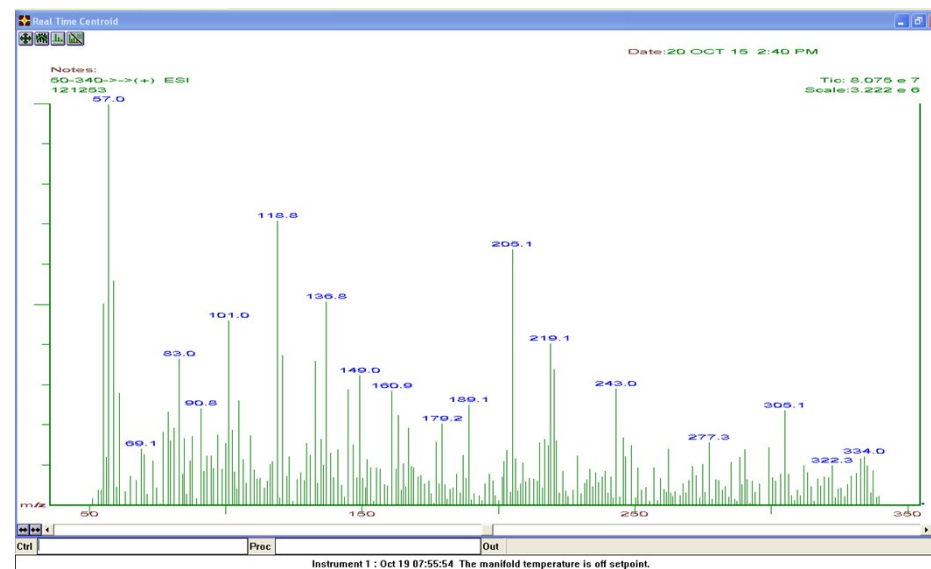
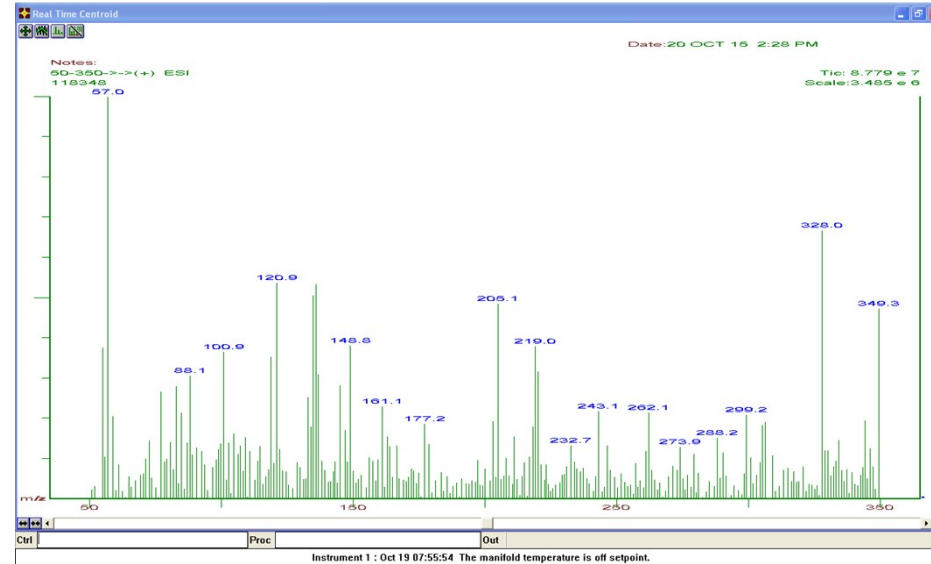
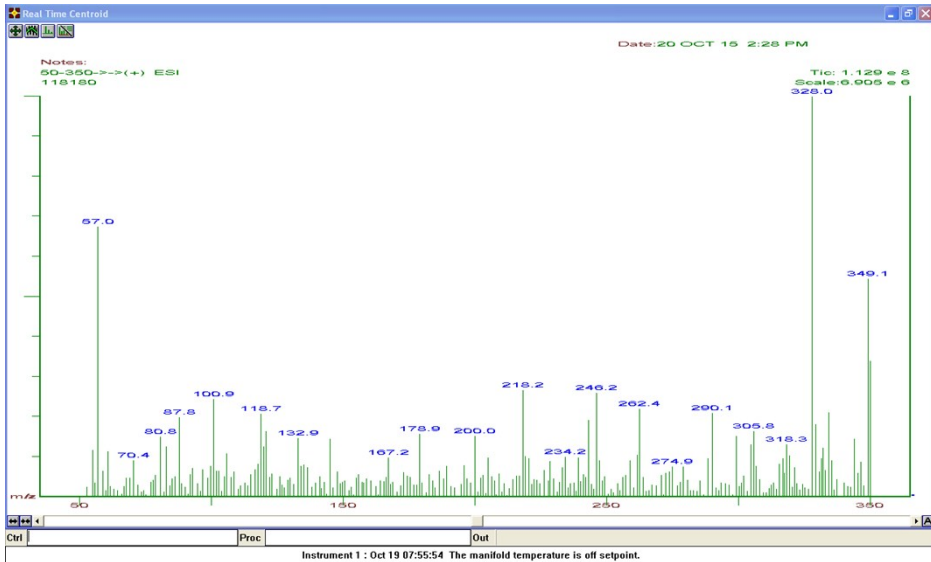


Figure 4S GC-LS spectra of MO for the detection of different fragment from the photocatalytic degradation experiments over S-doped TiO₂ photocatalyst.

Photocatalytic degradation of color (RhB) and colorless (Phenol) organic compounds

The as-prepared samples were used to evaluate the photocatalytic performance for color (RhB) and colorless (phenol) organic compounds degradation under visible light. For this purpose, Philips lamps were used as a visible light source equipped with a cut-off filter of 420 nm. Appropriate amount of photocatalysts (10mg) was added into 20ml of organic compound solutions (20mg/L of both dyes) in a beaker. The temperature of the photocatalytic reactor was controlled with the help of water circulation at room temperature. Prior to the photocatalytic experiment, the photocatalyst suspension into solution was set for ultra-sonication for 5 min and then placed under dark to achieve adsorption equilibrium. Then the suspension solutions were exposed to visible-light irradiation for specific interval of time. After that, lights were switch off and 5 ml of suspension solution was taken and photocatalyst was separated by centrifugation for 10 min at 12000rpm. The absorbance of the solution was monitored with the help Shimadzu-UV-1601 PC spectrophotometer. The change in organic compounds concentration after specific interval of visible-light radiation was monitored by measuring the absorbance of the solution. The photodegradation ratio of both organic compounds were calculated with the help of $X=(C_0-C_t)/C_0 \times 100\%$, where C_0 and C_t are the initial and final concentration of organic compounds for time t.

Fig. 5S shows the photocatalytic degradation efficiency of pristine and S-doped TiO₂ photocatalyst under visible–light irradiation. The degradation efficiency over pristine sample for RhB is negligible due to its incompetence ability for activation under visible-light irradiation. However, for S-doped TiO₂ photocatalysts, the photocatalytic activity is initially increased with the increase of S-doping concentration and reached to a maximum and then decreased. It is well-known that RhB consists of conjugated chromophoric ring (gives dark pink-color) to its appearance in solution. With the photodegradation of RhB over S-doped TiO₂ photocatalyst the concentration of total organic compounds (TOC) in solution decreased due to formation of more inorganic components (i.e. NH₄⁺/NO₃⁻) for higher S-doping levels. It took almost 60 min for 80% degradation of RhB under visible-light irradiation over S-doped TiO₂

photocatalyst (ATO-3). The mineralization of RhB started with the cleavage of conjugated chromophoric rings and then oxidation of intermediates into small less-toxic fragments.

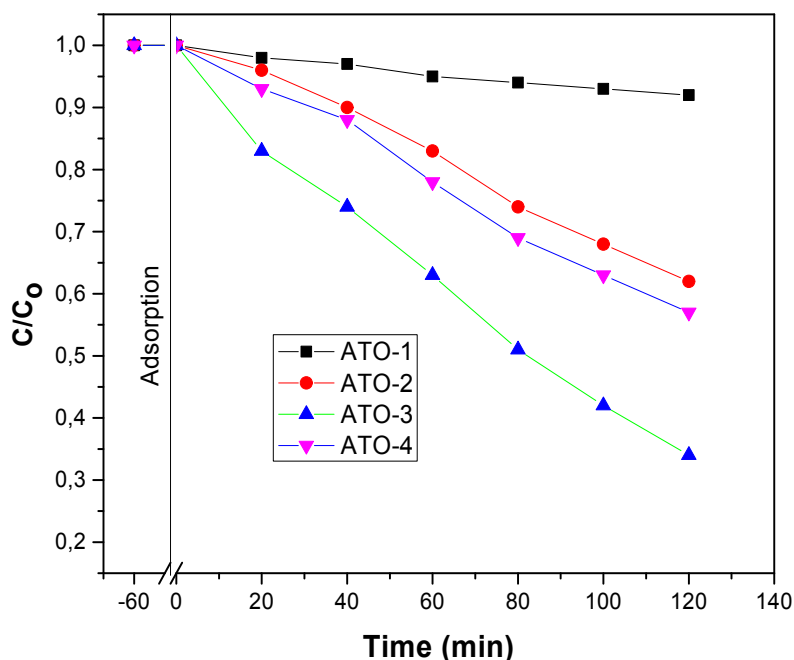


Figure 5S Photocatalytic kinetic for the degradation of RhB over undoped and S-doped TiO₂ photocatalyst under visible light irradiation.

Phenol, a colorless organic molecule and largely exist organic pollutants in industrial drain to enter into water resources was used as second target molecule to avoid the role photosensitiation in the degradation of color organic compounds (MO and RhB). Fig. 6S shows the photocatalytic degradation efficiency of phenol over undoped and S-doped TiO₂ photocatalysts under visible-light irradiation. As expected, the photocatalytic degradation of phenol over undoped TiO₂ sample was negligible as compared to S-doped TiO₂ photocatalysts under visible-light irradiation. The photocatalytic activity for S-doped TiO₂ photocatalyst increased with the increase of S-doping level due to creation of more oxygen vacancies at the surface of photocatalysts. After 180 min of visible-light irradiation almost 85% of phenol was degraded into small

less-toxic fragments. Highest photocatalytic activity was noted for moderately S-doped TiO₂ sample (ATO-3) as compared to other samples. Thus, S-doping largely effect and improved the photocatalytic efficiency of TiO₂ under visible-light irradiation.

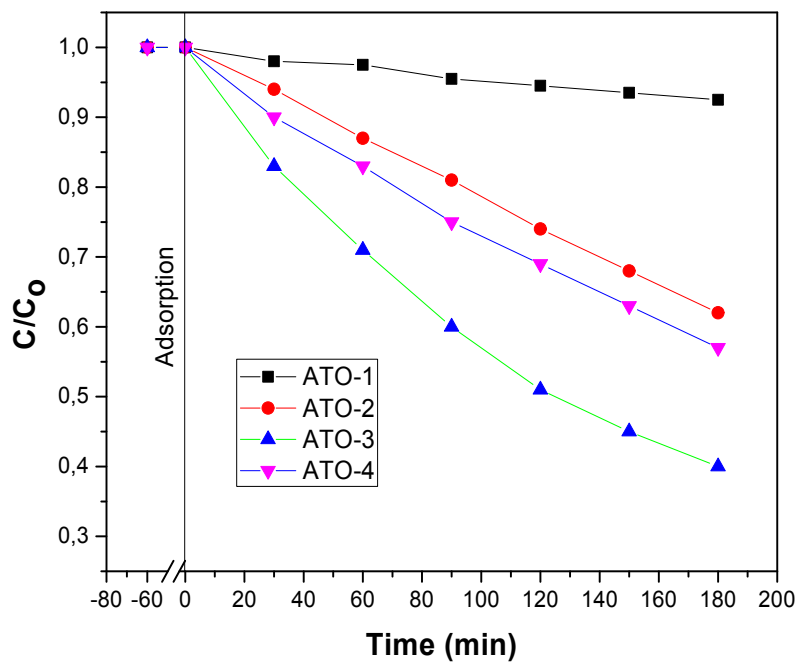


Figure 6S Evaluation of photocatalytic activity for the degradation of phenol (colorless dye) over pristine and S-doped TiO₂ photocatalyst under visible light irradiation.