Influence of Fe ions on the micro-structural characteristics sol-gel prepared TiO_2 particles

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Introduction

❖ **Titanium dioxide (TiO_2)**
- ✓ high photocatalytic activity in the UV light region
- ✓ high chemical and thermal stability

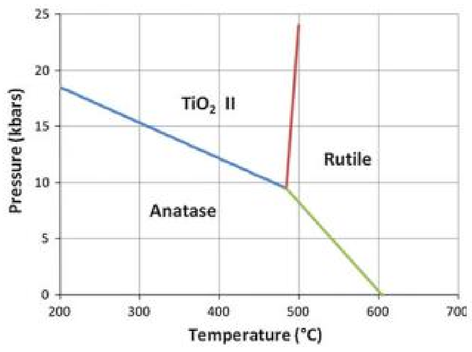
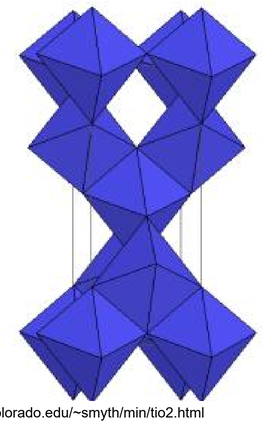


Figure 1: *Phase diagram of TiO_2*

❖ Three crystallographic forms:
- **Anatase - tetragonal structure**
- Rutile - tetragonal structure
- Brookite - orthorhombic structure



http://ruby.colorado.edu/~smyth/min/tio2.html

Figure 2: *Crystal Structure of anatase TiO_2[3].*

❖ **Addition of foreign ions**

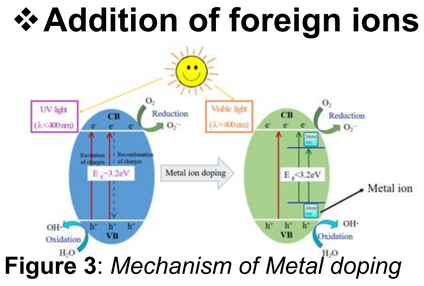


Figure 3: *Mechanism of Metal doping*

➢ It can alter the electronic structure, optical and chemical composition of TiO_2

➢ It could enhance the visible light absorption.

❖ Some of applications of TiO_2 :

➢ Photocatalysts

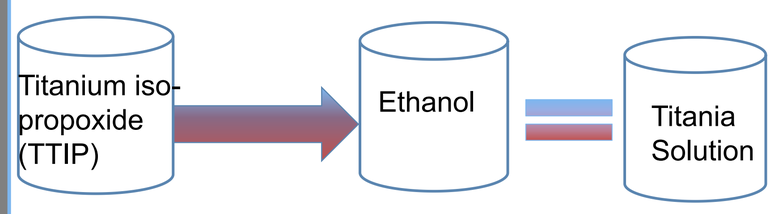
➢ UV sensors

Motivation of this Study

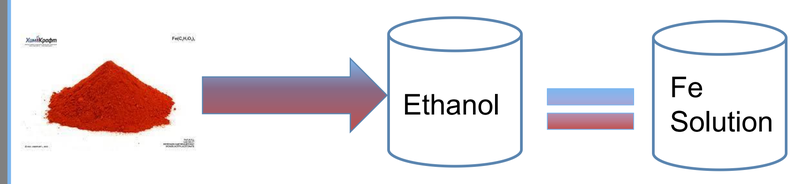
➢ The addition of foreign ions is being considered to extend the absorption of TiO_2 in the visible region

Methodology

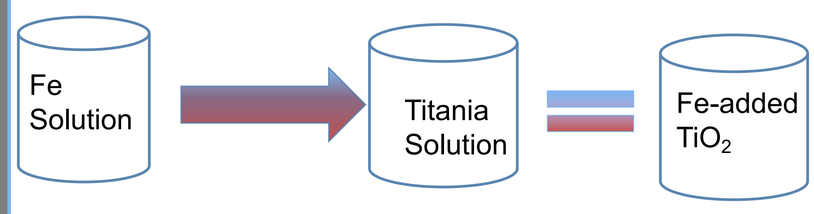
❖ **Preparation of Titania solution**



❖ **Preparation of Fe solution**



❖ **Addition of Fe solution to Titania solution**



Results and Discussions

X-ray Diffraction (XRD) spectroscopy

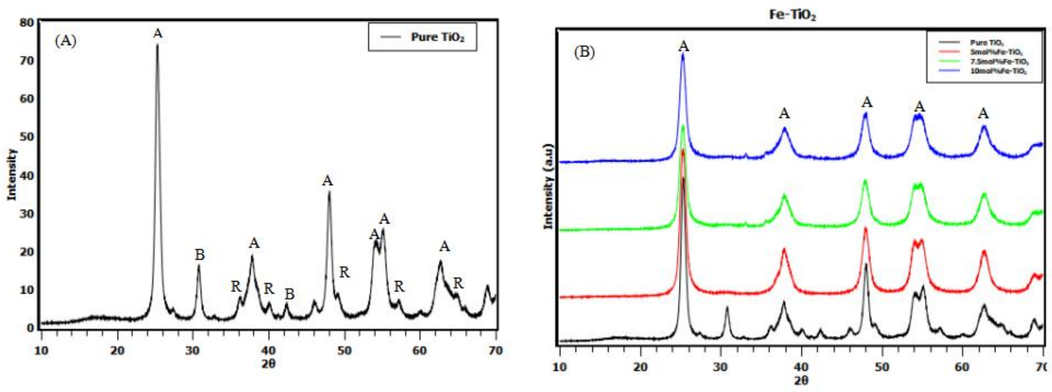


Figure 4: *XRD pattern of (A) Pure TiO_2 and (B) Fe-added TiO_2*

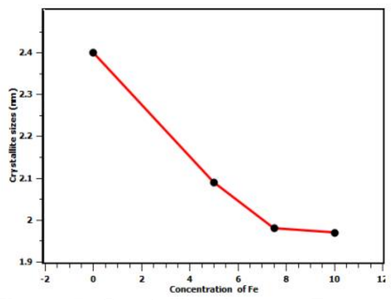


Figure 5: *Crystallite sizes vs. Fe concentration*

- The TiO2 particles are of anatase phase with a predominant orientation along the (101) plane.
- The crystallite size decreases from 2.4 nm to 1.97 nm with increasing the Fe ion concentration.
- This could be attributed to the substitution of Fe^{3+} to Ti^{4+} in the lattice of TiO_2

Scanning Electron Microscopy (SEM)

Figure 6: *SEM images of (A) pure and (B) 5mol%Fe-added TiO_2 (C)7.5mol%Fe-added TiO_2 (D)10mol%Fe-added TiO_2*

- The microscopy revealed that the TiO_2 is of sub-micron particle size and spherical morphology
- Interestingly, Fe-added TiO_2 particles (from 2.55 ± 0.360μm to 2.22 ± 0.360 μm) are smaller than pure TiO2 (3.83 ± 0.360 μm)

Conclusions

☐ Fe-added TiO_2 are successfully synthesized, furthemore, as increasing the Fe ions concentration the average crystallite sizes decreases indicate that the anatase was preserved even upon addition of Fe into TiO_2 .

☐ In addition, the microscopic observations, it revealed that the samples are made up of the fine structures these structure indicated as the spherical shape for the undoped and Fe-added TiO_2.

☐ The particles size of the sample decrease which is probably due to the substitution of Fe^{3+} to Ti^{4+} in the lattice of TiO_2 .

Acknowledgement

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