Int. J.Nano Dimens. 5(3): 305-308, Summer 2014
ISSN: 2008-8868

Contents list available at **IJND**

International Journal of Nano Dimension

Journal homepage: *www.IJND.ir*

Short Communication

Nanocomposites produced by Ag/TiO_2 sol–gel and their structure and spattering and characterization

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Received 13 February 2013
Accepted 17 May 2013

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ABSTRACT

Ag/TiO_2 photocatalytic nanoparticles by two methods, the sol – gel using a reducing agent and spattering was produced. Crystalline phase of Titanium dioxide was investigated in both. Ag/Tio_2 peak in the sol – gel method at temperatures of 300,500 and 600^0c were studied. Ag/TiO_2 peak at different temperatures were determined using the spattering. XRD patterns of calcined this is TiO_2 and Ag/ TiO_2.

Keywords: *Nanocomposites; Ag/TiO_2 sol–gel; Aspiring; Titanium dioxide; XRD patterns.*

INTRODUCTION

Semiconductors are a kind of material with an electrical conductivity between metals and insulators. The most important feature of these materials is the dependence of conductivity with temperature variation, light stimulation and impurities amount [1]. TiO_2 is one of the appropriate semiconductors of metal oxides that are used as a photo catalyst. Because it has a physical and chemical stability under reaction condition and also has high conductivity in visible light range. In addition to chemical, optical and electrical properties, these materials are used in sensors, solar cells, paint industry and environmental and waste pollutant. Nevertheless, there are many barriers for improvement of photo catalyst activity of TiO_2. Because this semiconductor has band gap of high energy near 3.2 electron-volts. This value cause the stimulation of TiO_2 under UV radiation with lower wavelengths from 388 nm due to difficulty of electrons injection to energy conductivity band and elimination of cavities from capacity band by this gap size [2]. In recent years, many efforts have been done for variation of TiO_2 adsorption edge from UV to invisible region such as contamination of that with impurities or creation of variation in that level [3]. Contaminations of TiO_2 by silver will decrease energy gap and hinder the combination of electron pairs-cavity. Silver has a significant catalyst property [4].

Silver is anti-bacterial and has the highest conductivity; also its absorption peak is stronger and clearer than other noble metals. Silver can combine with bimolecular and use for sensors [5]. There are many studies about mechanical and optical properties of TiO_2 which are influenced of following parameters:

Underlying temperature, discharge voltage, oxygen vapor pressure [6-7], TiO_2 is the first irregular network (amorphous), it is crystallized in three phases: 1.Anataste, 2.Rootile, 3.Brookit

The photo catalyst activity of TiO_2 in Anataste phase is more than Rootile phase [8-9] and the yield of photo catalyst activity in TiO_2 crystal is 2.2 times more than amorphous under fluorescent light. Finally, the nanoparticles novel metal oxides has more photo catalytic activity in comparison of their bulks [10-11] and this activity is dependent of cluster- shape and its distribution [12-13] that are determined using the property of oxide surface.

The properties of silver nanoparticles are dependant of their shape and size [14]. The place and peak width of Plasmon are dependant of free electron density on the nanoparticles surface and electron density increasing cause the movement of peak to higher energies [15].

EXPERIMENTAL

The production of photo catalyst nanoparticles Ag-TiO_2 with Sol-Gel method and using reducing agent have been done by Ci Lee et al. , Sun Ven et al. for the first time and then have been investigated. Ci Lee *et al.* produced Ag-TiO_2 using Sol-Gel method and by a reducing agent. They used Titanium tetra iso-propoxide (TTPI) and Ag-TiO2 as precursor for Titan and silver. Silver nitrate was mixed (1and 2 mmol) with 500 ml $4\frac{mmol}{L}$ sodium citrate (as reducing agent) ($C_6H_5Na_3$-$2H_2O$) and the reaction temperature has increased to 80°C using continues stirring. Then 1 mol TTPI and 0.15 mol nitric acid were added to solution. For completion of reaction, the solution was hold in 50°C for 24 h to production of Ag-TiO_2. The achieved gel was dried in 105°C for 24 h and then they were calcined under air in temperature range of 300-700 °C for 2 h.

Sun Ven *et al.*, produced Ag-TiO_2 using spattering method and investigated its structure and properties. They produced the thin layer of Ag-TiO_2 on quartz using spattering system and then it was produced by 3 separation sources using pull of powder in Rootile phase and then sedimentation of it under air in 1200° C for 5 h. The initial pressure of process was forced by pump and RF generator with 13.56 MHz. The damage pressure was 3×10^{-3} Torr. Firstly, TiO_2 and metal was yeast under pure argon gas for 10 min. The thickness of layers was 300 nm. Then fermented layers were heated in furnaces by 900°C and rate of $5\frac{^{\circ}C}{min}$ for 1 h. Then furnace was cooled by free air displacement and crystal was produced.

RESULTS AND DISCUSSION

In first experiment, the color of solution was changed from colorless to brown- amethystine that showing the silver reduction. Also, Figure 1 shows the peak of silver diffraction in Anatase crystal phase in 300 ^{o}C and this peak was disappeared with increasing temperature to 500 ^{o}C and then reaching to 600 ^{o}C that shows the peak of Rootile phase. Finally, narrowing and more steepen peaks by increasing calcinations temperature was resulted that the particles structure was moving to better and more appropriate crystalline state.

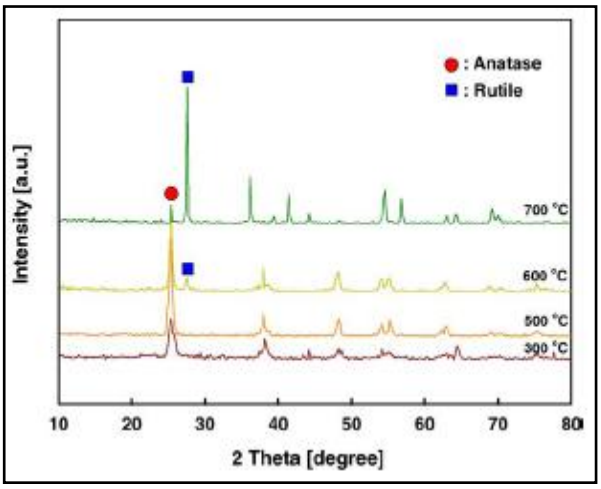

Fig. 1. XRD patterns silver diffraction in Anatase crystal phase in 300 ^{o}C to 700 ^{o}C.

The second experiment results were given in Figures 2 and 3 that show the XRD patterns of calcinated TiO_2 and calcinated Ag-TiO_2.

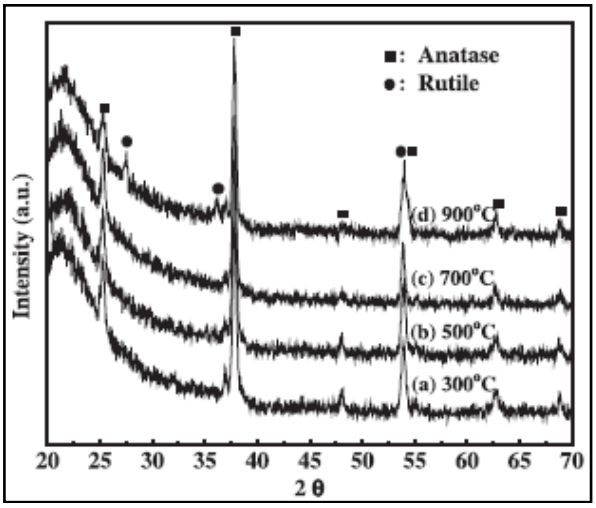

Fig. 2. XRD patterns of calcinated TiO_2

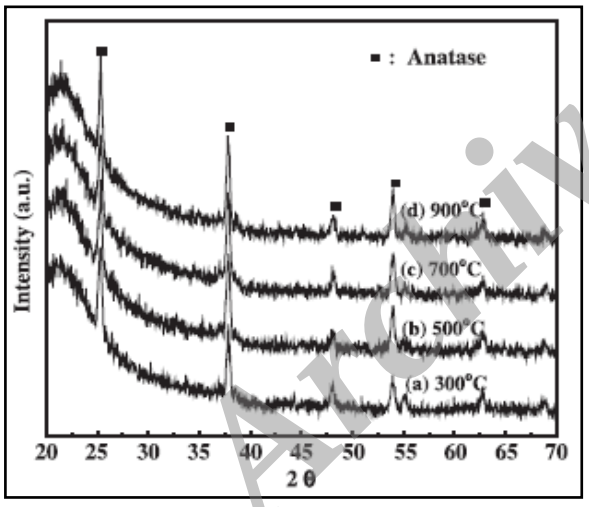

Fig.3. XRD anatase phase calcinated Ag-TiO_2.transformed to Rootile phase in 300-700 ^oC.

At first, no peak was observed for TiO_2 and Ag-TiO_2 that shows they are amorphous. However the peak of anatase phase was emerged in 300^{o}C and this phase was transformed to Rootile phase (Figure 2) in 300-700 ^oC.

Table 1 shows the increasing of Ag-TiO_2 crystal size by enhancement of 307 alcinations temperature. While the Ag-TiO_2 crystal size is less than pure TiO_2.

Table 1. Ag-TiO_2 crystal size and temperature

	TiO_2	Ag/TiO_2
300^{o}C Anataste (nm)	18	17
300^{o}C Rutile (nm)	-	-
500^{o}C Anataste (nm)	19	18
500^{o}C Rutile (nm)	-	-
700^{o}C Anataste (nm)	22	19
700^{o}C Rutile (nm)	-	-
900^{o}C Anataste (nm)	23	20
900^{o}C Rutile (nm)	21	-
900^{o}C W (%)	83	-

CONCLUSIONS

The photo catalytic properties of TiO_2 have been considered. The most important disadvantage is its properties appearance in UV region. So, the pure silver is used for production of particles with smaller size and high photo catalytic activity of TiO_2.

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Cite this article as: A. Tehranchi *et al.*: Nanocomposites produced by Ag/Tio_2 sol-gel and their structure and spatryng and characterization.
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