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Micro arc oxidation of nano-crystalline Ag-doped TiO_2 semiconductors

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ABSTRACT

Simple synthesis of silver doped TiO_2 nanostructured layers by micro arc oxidation process is reported for the first time. The layers consisted of anatase and rutile phases whose characteristic XRD-peaks shifted toward lower diffraction angles when compared to the pure micro arc oxidized TiO_2 layers. Silver-doping was confirmed by XPS technique. The anatase phase crystalline size was determined as 27.6 and 21.8 nm for the layers grown under the voltages of 350 and 500 V. Employing a UV–Vis spectrophotometer, a red shift in the absorption edge of the layers was observed when silver was incorporated into the titania lattice.

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1. Introduction

TiO_2 practical applications are limited due to its wide band gap and fast recombination of e^-–h^+ pairs within nanoseconds. So far, numerous researches have been focused on defeating these disadvantages among which introducing noble metals into titania lattice has been expressed as one of the most efficient ways [1–5]. Noble metals deposited or doped on TiO_2 have the high Schottky barriers among the metals and act as electron traps, facilitating e^-–h^+ separation and promotes interfacial electron transfer process [6]. These additives capture electrons resulting in lower recombination rate of e^-–h^+ pairs [1]. However, some noble metals such as Pt [2], Pd [3], Rh [4], and Au [5] are too expensive to be used on an industrial scale. Therefore, research on Ag-doped TiO_2 has a significant practical value [7]. Silver is suitable for industrial applications due to its low cost and easy preparation [8]. It is a suitable element which improves the TiO_2 photocatalytic performance [9,10]. It is also believed that silver ions interact with sulfur, oxygen, and nitrogen in the molecules of microorganisms and inactivate the cellular proteins resulting in titania better bioactivity [11,12]. Even though Ag-doped titania layers with different morphologies have been already grown by different methods namely sol–gel [13,14], PVD [15], spray [16], and so on, this is the first time that such layers are synthesized employing MAO technique. In our previous works, we fabricated V_2O_5–TiO_2 [17,18], WO_3–TiO_2 [19,20], and S:TiO_2 [21,22] layers by MAO process. In this study, Ag:TiO_2 layers were grown via MAO and the influence of the voltage on their physical and chemical properties is reported.

2. Experimental

Commercially pure (Grade II) titanium pieces with dimensions of 3 cm × 1 cm × 0.5 mm were used as substrate. Prior to MAO treatment, substrates underwent a cleaning process whose details as well as schematic illustration of the experimental setup can be found in our previous paper [23,24]. The cleaned substrates were micro arc oxidized

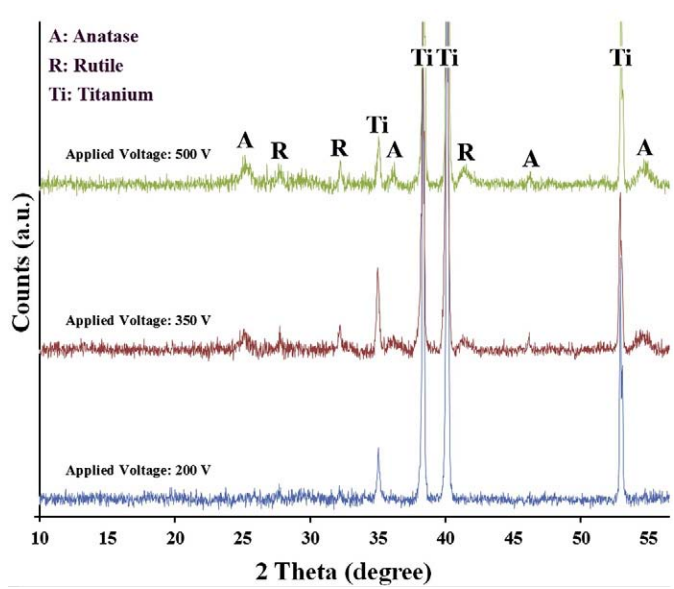

Fig. 1. XRD patterns of the grown Ag:TiO_2 layers.

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