

マグネトロンスパッタにより作製した酸化チタン薄膜の結晶構造及び光学・電子物性の評価

Characterization of TiO₂ thin film photocatalyst prepared by rf-magnetron sputtering

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TiO₂ thin films as a photocatalyst have gained great attention due to their superior properties such as high chemical stability, non-toxicity as well as their applications in the development of environmentally harmonious, sustainable, and energy-efficient technologies [1,2]. Radio frequency (rf) magnetron sputtering have been one of the preferred methods for synthesizing TiO₂ thin films as it can produce a highly uniform thin film, where the relation between sputtering conditions and structural, optical and morphological properties of thin films were mostly focused. In the present study, using rf magnetron sputtering, we prepared TiO₂ thin films with different thickness on a quartz substrate by changing the deposition time, and their optical, structural, and electronic properties were investigated by several characterization techniques. Figure 1 shows the X-ray diffraction (XRD) and tauc's plot of prepared thin films of different thickness by changing the deposition time from 1, 2 and 4 hours, respectively. The anatase phase of TiO₂ in all the films was confirmed by XRD measurements. The crystalline size was calculated to be about 50 nm in all films, which are enough large so that quantum size effect is negligible. With thicker films, optical bandgaps were found to increase from 3.22 to 3.36 eV. Photoluminescence studies suggest that oxygen vacancy appears to be much more dominant in thick TiO₂ films. These oxygen vacancies are expected to be responsible for an optical band gap enlargement. Further, other properties such as surface crystal structures and band structures will be discussed in the presentation. This work was supported by JSPS KAKENHI Grant Numbers 17K05103, 18K14147.

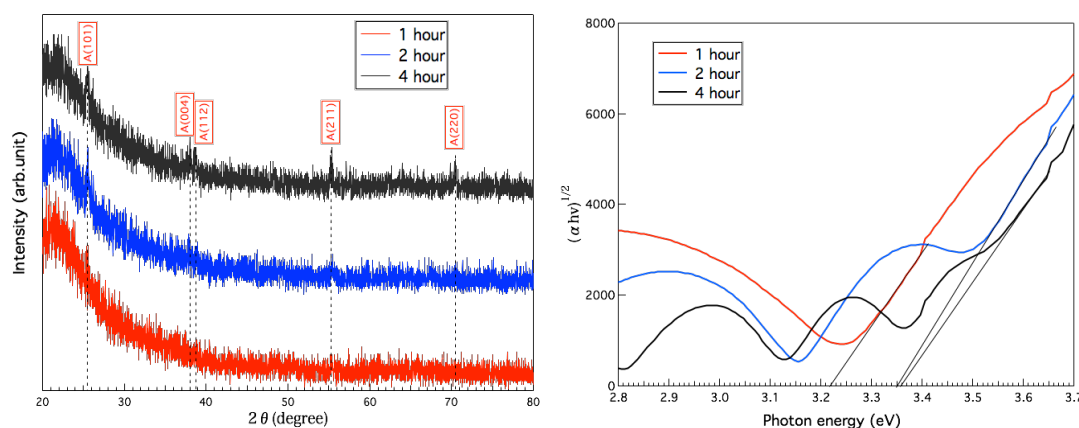


Fig. 1. X-ray diffraction patterns (left) and tauc's plot (right) of TiO₂ thin films for different deposition times (thickness).

References: [1] C.G. Kuo et al., Appl. Surf. Sci. 258 (2012) 6952-6957. [2] X. Chen et al., Chem. Rev. 107 (7) (2007) 2891-2959.