Electrophoretic Deposition of Titania Nanosheet Thin Films and their Photocatalytic Activities

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Abstract

In the past decade, increasing attention has been paid to the delamination of a number of layered host compounds. The exfoliated single sheets can be considered as new classes of nanoscale materials, which may exhibit novel physical and chemical properties associated with their thickness of nanometer order. Titania nanosheets (TN) are well characterized and applied by Sasaki and co-workers,[1] which have nanosized two-dimensional semiconductors. They should be interesting and useful as a relative from of a versatile material of titanium dioxide, which is attracting much attention for various applications such as photocatalysts.

Titania nanosheet (TN) thin films were deposited on indume tin oxide (ITO) substrate by electrophoretic deposition method (EPD), which have layered structure and exhibit a good transparency at visible region (Figure 1). Based on the quartz crystal analysis (QCA), the deposited amounts of TN were strongly affected by the concentration of TN. The viscosity and pH values were increased with the increasing of TN concentration, these suggest that the deposition weights considered to be governed by a delicate balance of the TN solution viscosity and surface charge of TN layer. The strength of deposited film is improved by the addition of polyvinylacohol (PVA) without changing the film properties, such as, the deposition weight, the film structure and the optical transmittance. Methyl viologen (MV^{2+}) molecules were intercalated into TN layer and irradiated absorption band of TN, TN/MV^{2+} thin film exhibit blue colure due to the formation of reduction products from MV^{2+} (Figure 2), indicate photocatalytic activities of the TN, when deposited on ITO by EPD method. The reduction products of MV^{2+} were stable in TN thin film and the lifetime of reduction products were 18 times longer than that in the absence of TN system. These results indicate that strong and close film formations were obtained by EPD methods on the ITO electrode.

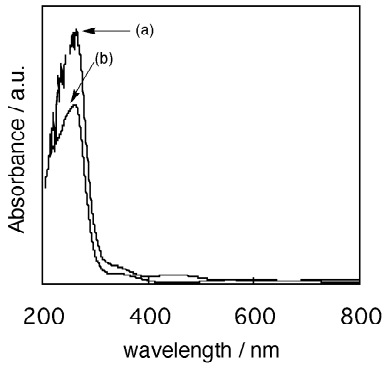

Figure 1. Absorption spectra of (a) TN thin film by EPD method and (b) aqueous dispersion.

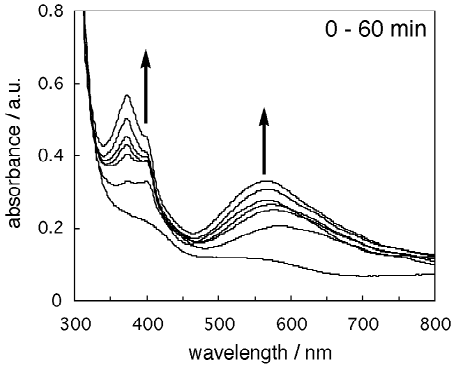

Figure 2. Absorption spectral changes with the 300 nm light irradiation for TN/MV^{2+} thin film, irradiation time 0 – 60 min.

REFERENCE

1. Sasaki et al. J. Am. Chem. Soc. **1996**, *118*, 8329.