Exfoliation and Photoelectrochemical Property for Ta_6O_{17} Nanosheets

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Layered tantalum oxides are one of the superior candidates of photocatalysts for water splitting. $Rb_4Ta_6O_{17}$ is composed by two dimensional host tantalum oxide layers with guest Rb^+ ions. This type of layered oxide has intercalation property and some of them can be exfoliated until a single host layer (oxide nanosheets) by the intercalation of large sized amines. The oxide nanosheets can be absorbed on the substrate by electrostatic principle (Layer-by-Layer technique; LBL) because they have negative charge. We have found that Nb_6O_{17} nanosheets electrode generates a large photocurrent of CH_3OH oxidation by a photoelectrochemical measurement.[1)] In this study, we report for the first time, the exfoliation of $Rb_4Ta_6O_{17}$ to a single host layer and the photoelectrochemical property.

$Rb_4Ta_6O_{17}$ was synthesized by a conventional solid state reaction. A mixture of Rb_2CO_3 and Ta_2O_5 with molar ratio of 2.2: 3 was heated in air at 1200°C for 2h. After preparing a proton-exchanged powder treated by a nitrate acid, Ta_6O_{17} nanosheets suspension was prepared by stirred proton-exchanged powder in tetrabuthylammonium hydroxide (TBAOH) solution. The nanosheets electrode was prepared by LBL technique using the suspension and polyethyleneimine solution. All electrochemical experiments were carried out in a conventional three-electrode electrochemical cell.

According to the XRD measurement, synthesized powder was confirmed $Rb_4Ta_6O_{17}$. After protonation, the powder was stirred in TBA solution which shows a tyndall scattering clearly. Moreover, the precipitation which was obtained by centrifugation of suspension under 3000rpm 20min was measured by XRD. It showed that the d value of the diffraction peak increased to 2.7nm due to the intercalation of TBA molecules in the interlayer space. Figure 1 shows the AFM image of Ta_6O_{17} nanosheets. It will indicate that the layered oxide was exfoliated to a single host layer because a thickness is about 1nm. Ta_6O_{17} nanosheets can be succeeded to absorb on the substrate by LBL technique, and the film generated photocurrent by irradiated UV light.

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