

36-60 Electrostatic self-assemble deposition of titanate (IV) layered oxides intercalated with transition metal complexes and their electrochemical properties

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The electrostatic self-assembly deposition (ESD) of the titanate layered oxides intercalated with some transition metal complexes, their phase changes with heat treatment, and their electrochemical properties have been demonstrated. The ESD occurred when both the solutions containing the complex cations with positive charge and the exfoliated Ti-O nanosheets with negative charge were mixed at an appropriate pH. The resulting deposits were the intercalated titanate oxides with a single-phase layered crystal structure in (0k0) orientation. The hexaammine complex intercalated samples possessed a layer distance of ~ 11.5 Å, whereas the Ru(bpy)₃²⁺ intercalated one had a layer distance of 16.6 Å. The heat-induced phase change and thermal behavior of the films depending on the intercalated complexes were discussed on the basis of various thermogravimetric differential thermal analysis (TG/DTA), X-ray diffraction analysis (XRD), and X-ray photoelectron spectroscopy (XPS) data. In the case of Ru(bpy)₃²⁺ intercalated sample, the heat treatment at 300 °C resulted in the strong combination of the complex with the Ti-O host layers and then brought about the visible light photocurrents. In general, the intercalated transition metal complex cations acted as the recombination center for the electron and hole produced in the host Ti-O layers under UV illumination. The Ag(NH₃)₂⁺ intercalated in the interlayer showed a clear redox electrochemical reaction in which fine Ag metal particulates were produced by the electrochemical reduction. The mechanisms of the electrochemical and photoelectrochemical properties of the intercalated Ti-O oxides are discussed in detail on the basis of the interaction between the intercalated complexes and the Ti-O host layers, as well as their energy positions.

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