38-21 Electrochemical and photoluminescence properties of layered oxides prepared by electrostatic self-assembly deposition techniques

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Various metal cations were intercalated into the interlayer of the exfoliated Ti-O, Mn-O, and Nb-O layered oxides by electrostatic self-assembly deposition (ESD) and layer-by-layer self-assembly (LBL) methods in a solution. X-ray diffraction, ICP, and thermal analysis data indicated that interlayer metal cations existed as an aqua ion and were coordinated with water molecules at ambient conditions. Silver ion intercalated in Ti-O and Mn-O layered oxides showed the redox reaction of silver ion/ silver atom. The nucleation to silver metal was suppressed in the interlayer space. The layered oxides intercalated with Ru complex showed a visible light response in the photoelectrochemical measurement. The photoresponce of the Ru complex gives the photocurrent of the layered oxide via the host layer. Nb-O layered oxide intercalated with Ru complex gives water split under presence of alcohol under visible light illumination. The Nb-O layered oxide with perovskite host layer showed high photo-oxidation current of methanol. This is due to the intercalation of methanol and then oxidized with hole produced in the host layer. Probably perovskite host layer acts as a separation part for the electron/hole pair.

Intercalation of lanthanide cations into the interlayer by LBL method was monitored by UV-vis spectrum and X-ray diffraction. Photoluminescence properties were also discussed in detail. Eu^{3+} intercalated layered oxide exhibited intense red emission at room temperature. The presence of interlayer water molecules was found to be inevitable for the emission with high intensity. The emission intensity was significantly high for the films conditioned at 100% RH than those at 5% RH. The ice-like behavior of the confined water molecules in the interlayer around lanthanide cations was believed to be contributing highly to the emission mechanism. The mechanism was illustrated and explained by data obtained under several conditions.

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