38-23 Synthesis of Photoluminescent Titanate Layered Oxides Intercalated with Eu^{3+} by Electrostatic Self-Assembly Methods

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Layered oxide materials give rise to a variety of interesting properties. Emission by an energy transfer process from the excited host matrix to the in-matrix lanthanide cations has been reported for various oxides doped with lanthanide cations. This behavior suggests that lanthanide cations in the interlayer of the Ti layered oxides might result in a strong emission under the excitation of the host layer. Thus, the intercalation and photoluminescent properties of Eu^{3+} in the interlayer of exfoliated $H_xTi_{(2-x/4)}\square_{x/4}O_4.H_2O$ (HTO) have been investigated in this study. The intercalation of Eu^{3+} was carried out by electrostatic self-assembly deposition (ESD) and layer-by-layer assembly (LBL) methods. X-ray diffraction and thermal analysis data indicated that interlayer Eu^{3+} existed as an aqua ion and were coordinated with 7-10 water molecules at ambient conditions. The interlayer distance was around 7 Å. Intercalation of Eu^{3+} into the interlayer by LBL method was monitored by UV-vis spectrum and X-ray diffraction. Photoluminescent properties were also discussed in detail. Eu^{3+} intercalated layered oxide exhibited intense red emission at room temperature. Confined water molecules in the interlayer around Eu^{3+} were believed to be contributing highly to the emission mechanism. The emission intensity was significantly high for the films conditioned at 100% RH than those at 5% RH. Probably, water molecules in the interlayer will be fixed via hydrogen bonding, as in ice, leading to decrease the radiationless quenching on water molecules. The mechanism was explained by data obtained under several humidity and thermal conditions. In conclusion, this study shows the successful intercalation of Eu^{3+} into the interlayer of titanate layered oxides by LBL and ESD methods and also shows the importance of the water in the interlayer for high emission at room temperature.

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