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Electronic Supplementary Information

Relationship between interlayer anions and photoluminescence of layered rare earth hydroxides

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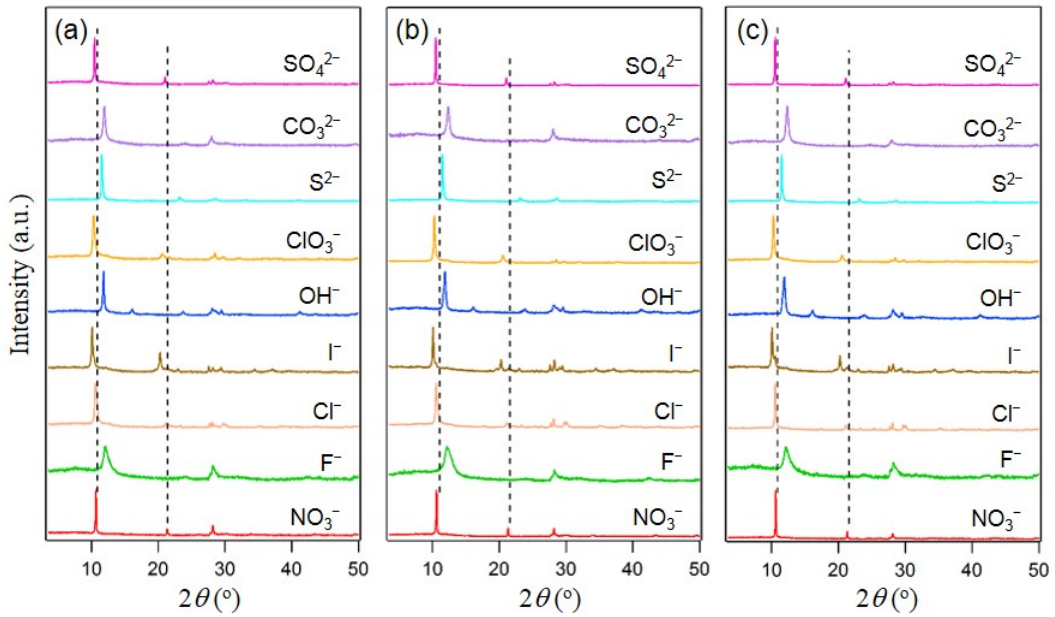

Fig. S1 Powder X-ray diffraction patterns of $Gd_{1.80}RE_{0.20}(OH)_5X{\cdot}nH_2O$ (LGdH:RE) where RE = (a) Eu, (b) Tb, and (c) Ce and X = NO_3^-, F^-, Cl^-, I^-, OH^-, ClO_3^-, S^{2-}, CO_3^{2-}, and SO_4^{2-}. Dotted lines indicate the Bragg angle of (002) and (004) diffractions of corresponding X = NO_3^- members.

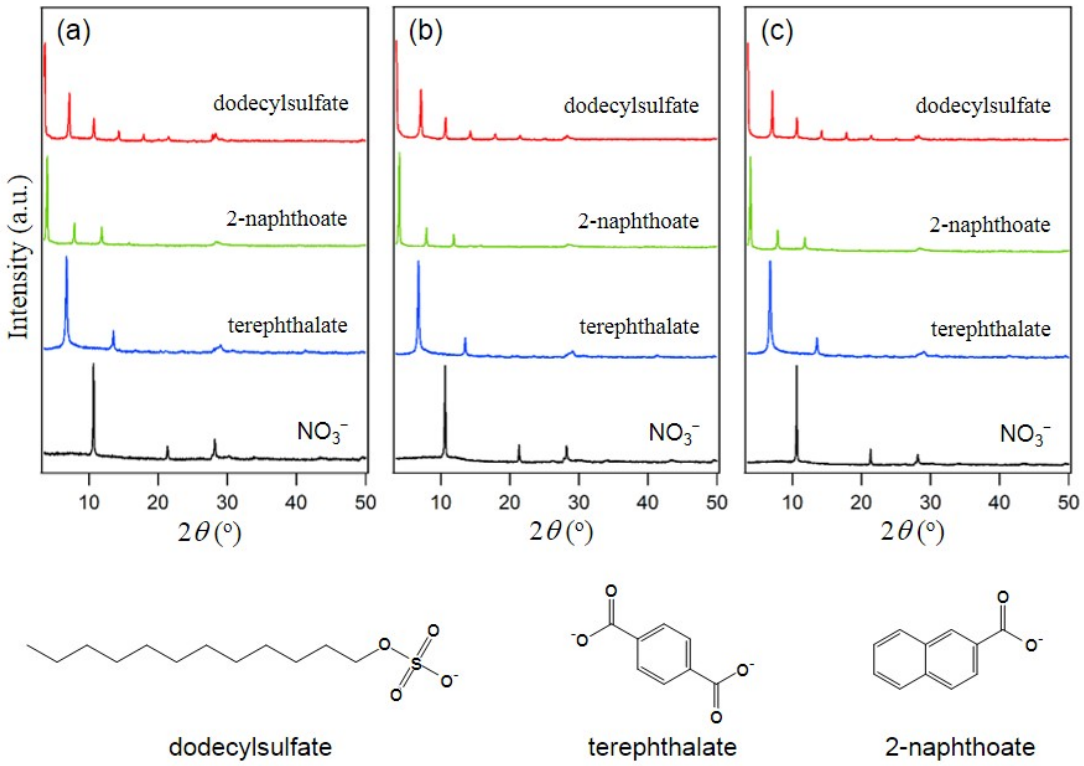

Fig. S2 Powder X-ray diffraction patterns of $Gd_{1.80}RE_{0.20}(OH)_5X{\cdot}nH_2O$ (LGdH:RE) where RE = (a) Eu, (b) Tb, and (c) Ce and X = NO_3^-, terephthalate, 2-naphthoate, and dodecylsulfate.

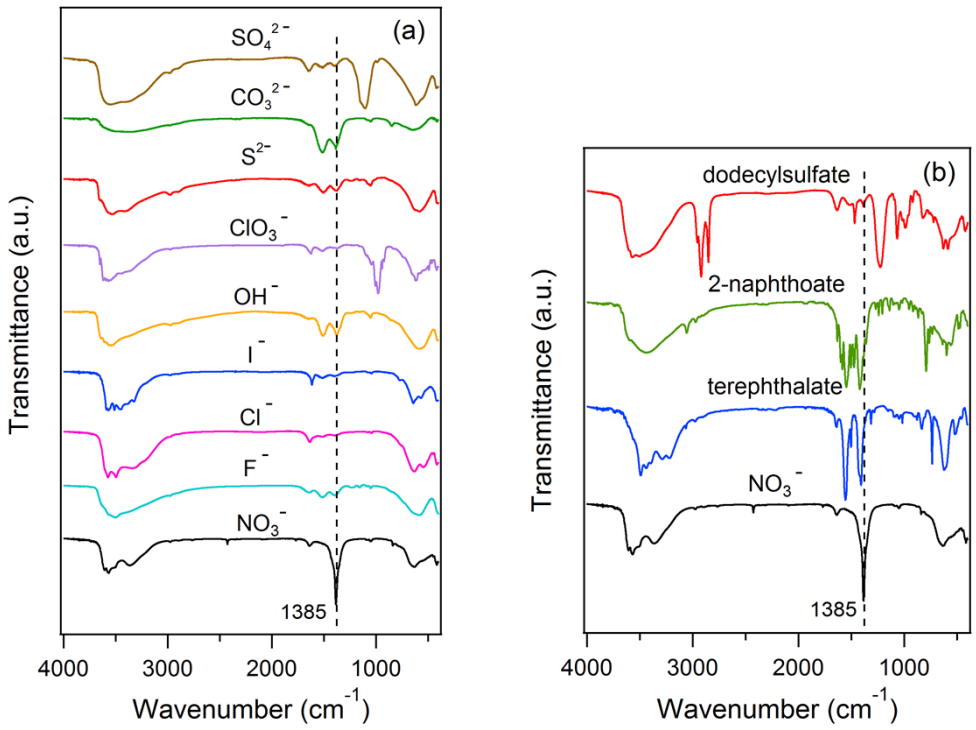

Fig. S3 FT-IR spectra of $Gd_{1.80}Eu_{0.20}(OH)_5NO_3{\cdot}nH_2O$ (LGdH:Eu) and its products obtained after exchange reaction between NO_3^- and (a) F^-, Cl^-, I^-, OH^-, ClO_3^-, S^{2-}, CO_3^{2-}, and SO_4^{2-}, and (b) terephthalate, 2-naphthoate, and dodecylsulfate. The disappearance or significant weakening of the band at ~1385 cm^{-1}, which is characteristic of NO_3^-, confirmed the essentially complete exchange reaction.

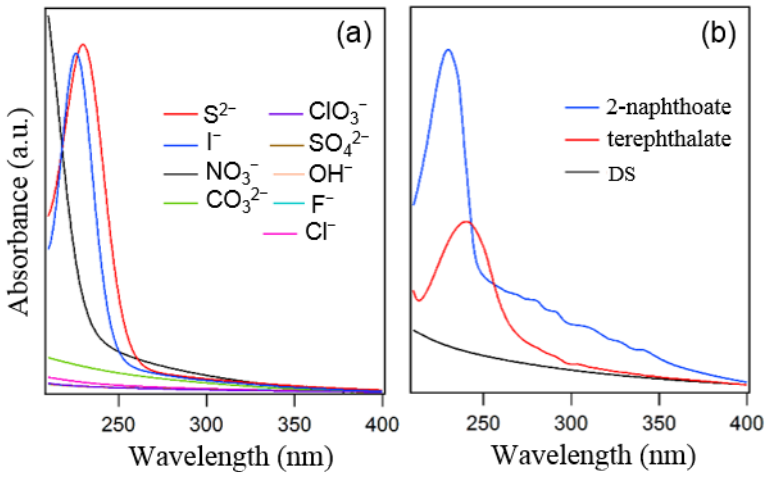

Fig. S4 UV-VIS absorption spectra of aqueous suspensions containing LGdH hosts (*i.e.* without any activator ion) with (a) NO_3^-, F^-, Cl^-, I^-, OH^-, ClO_3^-, S^{2-}, CO_3^{2-}, and SO_4^{2-} anions and (b) dodecylsulfate (DS), terephthalate, and 2-naphthoate anions in the interlayer space.

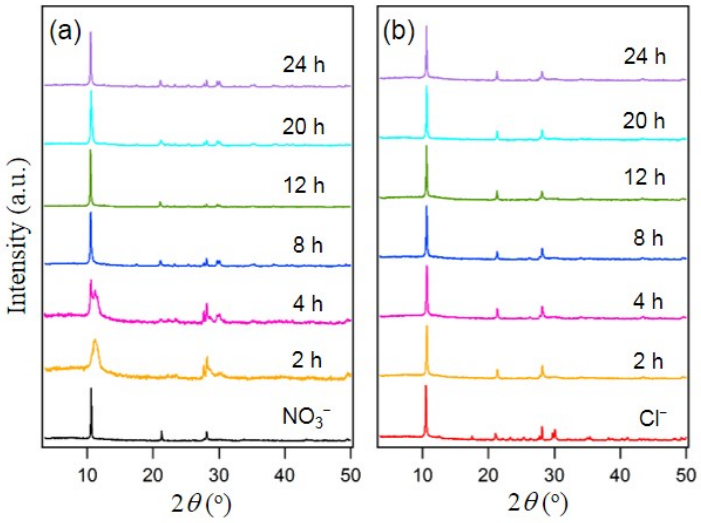

Fig. S5 XRD patterns measured as a function of reaction time during the exchange reaction of $Gd_{1.80}Ce_{0.20}(OH)_5NO_3{\cdot}nH_2O$ with Cl^- (a) and inversely $Gd_{1.80}Ce_{0.20}(OH)_5Cl{\cdot}nH_2O$ with NO_3^- (b). The transformation from $Gd_{1.80}Ce_{0.20}(OH)_5NO_3{\cdot}nH_2O$ to $Gd_{1.80}Ce_{0.20}(OH)_5Cl{\cdot}nH_2O$ requires the exchange reaction for at least 8 h whereas the inverse transformation from $Gd_{1.80}Ce_{0.20}(OH)_5Cl{\cdot}nH_2O$ to $Gd_{1.80}Ce_{0.20}(OH)_5NO_3{\cdot}nH_2O$ is complete even after 2 h reaction at room temperature.