

Synthesis and exfoliation of layered lanthanide hydroxide

大学院自然科学研究科 前期課程 園田優樹
" 助教 伊田進太郎
" 教授 松本泰道

Abstract

Lanthanide hydroxide nanosheets ($\text{Ln}(\text{OH})_{3-x}$) were prepared by exfoliation of layered lanthanide hydroxides intercalated with dodecyl sulfate ions ($\text{Ln}(\text{OH})_{3-x}\text{DS}_x$). The structures of the layered materials and the nanosheets were characterized by X-ray diffraction (XRD), transition electron microscopy (TEM), and atomic force microscopy (AFM). The thicknesses of the $\text{Ln}(\text{OH})_{3-x}$ nanosheets were about 1.4 nm, which was smaller than the basal spacing of the parent $\text{Ln}(\text{OH})_{3-x}\text{DS}_x$, indicating successful exfoliation of the layered lanthanide hydroxides to the $\text{Ln}(\text{OH})_{3-x}$ nanosheets.

Results and Discussion

Figure 1 shows the XRD pattern for the layered europium hydroxide intercalated with DS^- , ($\text{Eu}(\text{OH})_{3-x}\text{DS}_x$), where several (00 l) reflections were observed. The basal spacing calculated from the diffraction angle was 2.69 nm. In addition, several weak non-(00 l) reflections at 28.04° (0.318 nm), 49.36° (0.184 nm), and 58.00° (0.159 nm) were observed. These peaks are due to diffraction from the direction of the plane of the host europium hydroxide layer. Similar layered lanthanide hydroxide materials can be synthesized from La, Nd, Sm, Gd, Tb, Dy, Ho, Er, Tm, Lu. Several (00 l) reflections and several weak non-(00 l) reflections were observed. The 2θ angles for the several non-(00 l) reflection increased with decreasing the ion radius of Ln^{3+} .

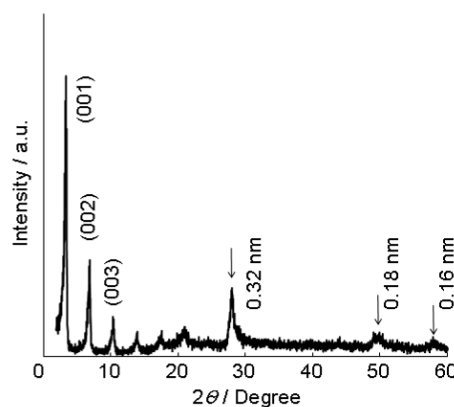


Fig. 1. XRD pattern of the DS^- intercalated layered europium hydroxides

Conclusion

We succeeded in exfoliation of layered lanthanide hydroxides intercalated with dodecyl sulfate ions ($\text{Ln}(\text{OH})_{3-x}\text{DS}_x$) to $\text{Ln}(\text{OH})_{3-x}$ nanosheets in formamide solution. The thicknesses of the $\text{Ln}(\text{OH})_{3-x}$ nanosheets were about 1.4 nm. To the best of our knowledge, this is the first report on preparation of layered lanthanide hydroxide nanosheets by exfoliation process. The colloidal solutions of the $\text{Ln}(\text{OH})_{3-x}$ nanosheets exhibited various emission spectra from visible to near-infrared were observed by the direct excitation ($f-f$ transition) of the lanthanide ion.