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ESR study of rare earth elements adsorbed on kaolinite

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Clay minerals have received attentions as the material for adsorption of radioactive ions in the project of nuclear waste repository or selective adsorbent of the ions [Sridhar et al., 2001]. Rare earth ions can be used as simulation study for adsorption coefficient of actinides on clay minerals, because both ions have f-electrons in outer shell and their chemical properties are quite similar. However, rare earth ions adsorbed in clay minerals are poorly studied using ESR. In this paper, we studied kaolinite adsorbing rare earth, gadolinium ion to evaluate the possibility to use kaolinite for isotope adsorption material.

In first experiment, kaolinite was immersed in the 0.001 mol/l or 0.01 mol/l of GdCl3 6H2O solution for 70 hours at room temperature. The sample was filtered, washed by distilled water and desiccated for several hours at 40 degree C. The ESR signal at g = 2.6 was observed in both samples and associated as Gd3+ because the hyperfine splitting of Gd3+ was observed at microwave power of 10 mW. ESR signal of radiation-induced center in the kaolinite was also observed and its ESR intensity was saturated at the 10 mW of microwave power. Unfortunately, the complication of the signal due to the site of the adsorbed Gd3+ made it difficult to determine the hyperfine splitting constant.

In second experiment, the concentration change of Gd3+ adsorbed in kaolinite to sample depth was studied as follows. The handmade tower of acryl pipe diameter of 3 cm was filled by kaolinite at the depth of 10 cm. The bottom of the pipe was covered with the filter paper. The 0.01 mol/l of GdCl3 6H2O solution was slowly poured into the pipe using a buret at the same volume with the kaolinite. The amount of the solution passing the sample per hour was about 5 ml. ESR measurements of the sample from each distance from the surface showed that the intensity of the signal decreased exponentially with rate 0.01 [mm-1], with increasing of depth. This implies 2.9 m of the kaolinite layer should be necessary to adsorb 99% of Gd3+ ion in the solution. [Matsuda et al., 2002]

In the presentation, we well discuss the usefulness of kaolinite as materials adsorbing radioactive elements with the results of ICP-MS analysis.

Matsuda, T., Yamanaka, C. and Ikeya, M., (2002 in press) Proc. Int. Symp. ESR Dosimetry and Dating, Osaka (2001)

Sridhar, K., Naofumi, K. & William, J., P., (2001). Nature 410, 771.