Chemical Species of Magnesium in Steel Slag Samples

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The steel slag produced in the process of steel manufacture contains many nutritional elements that can be used as fertilizers, such as phosphorus, calcium, and magnesium. Approximately 260,000 tons of phosphorus are contained annually in sewage sludge, livestock waste and steelmaking slag, which are almost equivalent to the need of phosphorus in Japan. Steelmaking slag has a lower water content and higher density than sewage sludge and livestock waste, and can be used as fertilizer. Since slag has a high concentration of phosphorus, calcium and magnesium, it can be used for lime fertilizer for acid soils.

Magnesium is known as a macronutrient element in plants, but there is a lack of information on its chemical form in slag samples. Our preliminary study demonstrated that magnesium contained in slag may contribute to the improvement of nutrient uptake by crops. The objective of this study was to investigate the chemical form of magnesium contained in steelmaking slag using Mg K-edge XANES. Surface-sensitive electron yield mode specialize in the analysis of the outermost surface of slag samples. By simultaneously performing the measurement by the fluorescence yield mode, a spectrum containing information deeper than the electron yield mode can be obtained. From the comparison of both spectra, we also aimed to obtain knowledge about the chemical state of magnesium in the vicinity of the surface layer of slag.

To determine magnesium species in slag samples, known magnesium compounds and minerals were analyzed. The XANES spectra were also collected from steel slag samples. Magnesium K-edge XANES spectra were collected by TEY and PFY modes at BL-10, Ritsumeikan University SR center.

Figure 1 shows the XANES spectra of Mg containing compounds and minerals. The spectra were different in compounds and minerals suggesting that using these standards may determine Mg species in slag samples. For example, the MgO standard had a peak at 1309 eV, whereas $Mg(OH)_2$ did not show this peak. The XANES spectra of the slag samples showed different structures. The XANES spectra of all slag samples measured in this experiment had a peak at 1309 eV, although its intensity varied in the slag samples. The XANES spectra of the slag samples were similar to the spectra of MgO and $Mg(OH)_2$. Further studies are needed to determine the major Mg compounds in the slag samples to increase the number of standard spectra of known compounds.

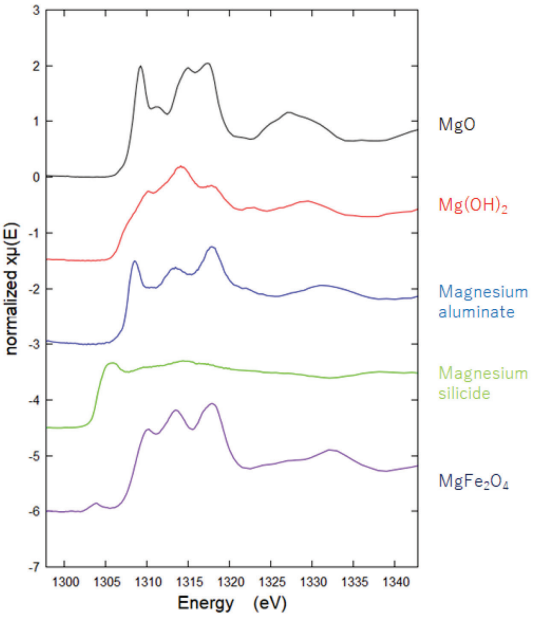

Fig. 1 Magnesium K-edge XANES spectra of standard minerals and compounds.