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Chemical State Analysis of Strontium Attached to Structural Materials of Reactor Building

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1 Introduction

For decommissioning of the Fukushima Daiichi Nuclear Power Station, it is necessary to manage the dismantling wastes safely and rationally. In order to understand the penetration mechanism of radioactive species in the structural materials, the penetration of two types of solution and the EXAFS characterization of species after penetration have been carried out, and the variation of the coordination environment depending on the depth has been identified.

2 Experiment

EXAFS measurements have been performed on concrete with different aggregate content that was subjected to Sr penetration test in High Energy Accelerator Research Organization Photon Factory BL-27B by transmission mode. Concrete specimens immersed in 1M $SrCl_2$ or $Sr(OH)_2$ solution for one day were scraped with sandpaper to 2.0 mm by 0.5 mm from the surface, and the resulting concrete powder was focused on the SrK absorption edge. The structural function of the concrete was compared according to the type of concrete and the soaking solution. The obtained X-ray absorption spectra were analyzed by the XAFS analysis program WinXAS ver. 3.02 to obtain the various structural parameters.

3 Results and Discussion

The results obtained by the analysis and compared against the Sr neighbor structure in concrete of Sr-containing samples from $SrCl_2$ and $Sr(OH)_2$ penetration tests are shown in Figs. 1 and 2, respectively. The first nearest-peak in the structure function can be seen around 2 Å in both Figures 1 and 2. The position of the $SrCl_2$ aqueous first-neighbor peak (around 2 Å) changes slightly with depth, which may indicate a correlation between the Sr atoms and the oxygen from the concrete in the immediate vicinity, resulting in a variation in the structure. In the case of concrete immersed in $Sr(OH)_2$ solution, the intensity of the first neighbor peak, which represents the correlation between Sr and oxygen and their abundance, decreases with depth because Sr replaces Ca in the concrete. Since Ca is the main component of concrete, the coordination structure is expected to remain almost the same in the depth direction, and the difference in strength may be due to the difference in the degree of disorder. While, the depth profile of Cs did not show the same tendency as that of Sr, suggesting that the penetration mechanism of Cs may be different from that of Sr.

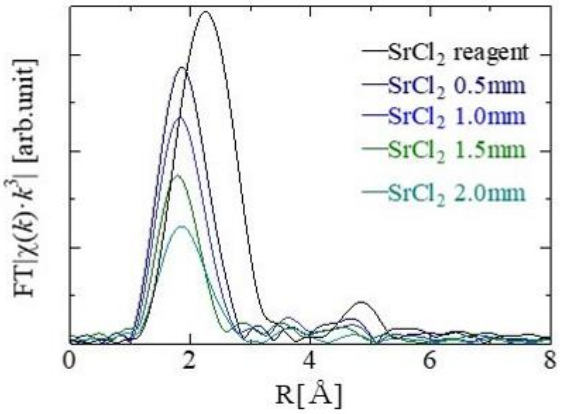

Fig.1 EXAFS structure functions of Sr-containing samples after $SrCl_2$ penetration test.

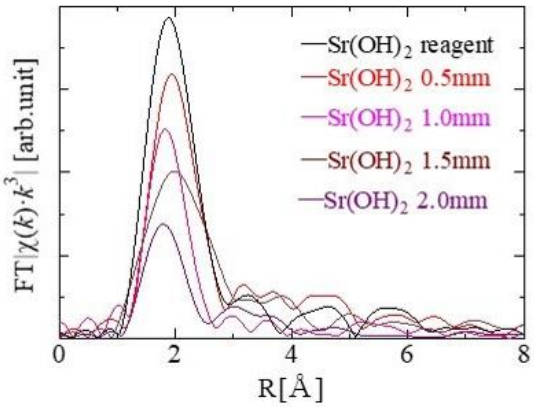

Fig.2 EXAFS structure functions of Sr-containing samples after $Sr(OH)_2$ penetration test

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