Research and development on preceding processing methods for contaminated water management waste at Fukushima Daiichi Nuclear Power Station

(23) Interaction between Iron Slurry and Alkali Activated Materials

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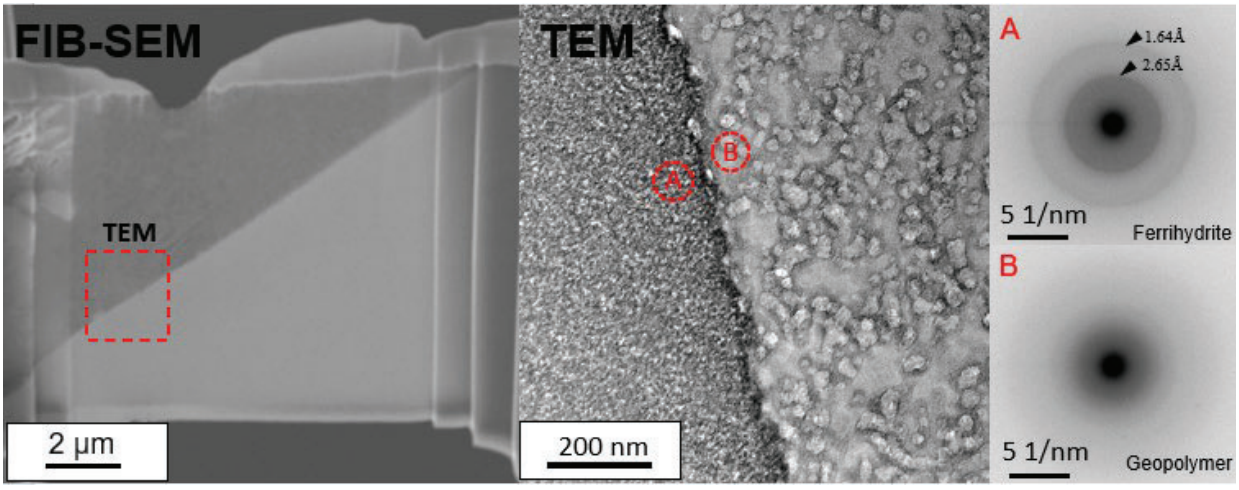
For long-term safety storage and disposal of iron slurry embedded into alkali-activated material (AAM), alteration of iron slurry and its interaction with AAM is crucial. In this context, the interfaces between iron slurry and AAM before and after the leaching test were investigated by electron microscopy analysis. No interaction of iron slurry within the AAM matrix was observed in nm space.

Keywords: Alkali-activated materials; Alteration; Interaction; Iron slurry; Transmission electron microscopy

Introduction The wastes stabilization such as carbonate and iron slurries (IS) generated from Fukushima Daiichi Nuclear Power Station (FDNPS) encapsulated by alkali-activated material (AAM) have been investigated. For the long-term safety of IS embedded into AAM storage, the alteration and interaction of iron slurry within AAM are crucial. In this context, the interfaces between iron slurry and AAM before and after leaching test were investigated by secondary electron microscope attached focused ion beam (FIB-SEM) and transmission electron microscopy (TEM).

Materials and Methods The metakaolin-based Na-based AAM with synthesized IS before and after leaching tests were cut into a wedge shape with a size of 15 μm length, 2μm width, and ~8μm height by FIB-SEM. The wedge-shaped samples were lifted and attached onto the tip of the TEM grid by an ex-situ micromanipulator. The attached samples were carefully trimmed to obtain less than 100 nm width by FIB-SEM. The prepared samples were analyzed by TEM with a condition of 200 KeV.

Results and discussion In this study, the synthesized IS was mixed with Na-based AAM during fabrication and leach for 28 days. TEM images, selected area electron diffraction (SAED), and energy-dispersive x-ray spectroscopy (EDS) showed that Na-based AAM had no phase change and no interaction with IS even after 28-day leaching (see the following figure). This is presumably due to low solubility of IS at even high pH condition. Phase change and/or alteration of IS are considered to induce change in performance of the waste and leaching of radioactive nuclides sorbed onto the IS. Therefore, the AAM may be preferable matrix for safe storage and disposal.



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