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Fluoridation and oxidation behavior of JLF-1 and NIFS-HEAT-2 low activation structural materials

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Corrosion of structural materials, such as JLF-1 (Fe-9Cr-2W-0.1C-V-Ta) and NIFS-HEAT-2 (V-4Cr-4Ti), is paid attention most in Flibe (LiF-BeF\textsubscript{2}) blanket development. In a previous corrosion study on steels, only oxides were identified as corrosion products after a conventional Flibe exposure test, while fluorides were indicated in another report with high purity Flibe after dehydration treatment. In order to clarify the corrosion mechanism in Flibe, it is essential to understand the competitive process by fluoridation and oxidation. Purpose of the present study is to characterize corrosion products of the low activation materials after fluoridation, oxidation and Flibe exposure tests, and to evaluate corrosion resistance of the materials in various conditions.

JLF-1 JOYO-II heat and NIFS-HEAT-2 were machined and polished into specimens with 1 x 10 x 20 mm or 1 x 10 x 15 mm in size. The same size specimens of pure Fe, Cr, W, V and Ti were also prepared. The specimens were exposed to HF-H\textsubscript{2}O solution at room temperature, and to flowing He-HF-O\textsubscript{2} gas mixture and static molten salt Flibe at 673-873 K. High purity HF gas was made by a reaction between NiF\textsubscript{2} and dehydrated He-H\textsubscript{2} gas mixture. Flibe was dehydrated by HF gas bubbling treatment. After the exposure tests, weight change was measured. Corrosion products and microstructural change at the surface were characterized by scanning electron microscopy (SEM) and X-ray diffractometry (XRD).

In a XRD spectrum of JLF-1 after Flibe exposure at 823 K for 2003 hr, some peaks considered as FeF\textsubscript{2} and CrF\textsubscript{2} were observed, however their intensity was not enough to identify the compounds. The morphology and composition of the corrosion products were analyzed by SEM and compared with the one made in accelerated fluoridation tests with various composition of He-HF-O\textsubscript{2} gas mixture.

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