U-Zr alloys fuel and ferritic-martensitic stainless (FMS) steel claddings have been considered as the most promising fuel for the sodium-cooled fast reactor (SFR) [1]. In this study, to investigate the fuel cladding chemical interaction (FCCI) of U-Zr-Ce fuel under a transient condition, high-temperature diffusion couple tests were conducted with irradiated U-10Zr-5Ce fuel slugs with T92 cladding at hot-cell in Korea Atomic Energy Research Institute (KAERI).

The fuel rod of U-10wt%Zr-5wt%Ce (U-10Zr-5Ce) with T92 (NF616) cladding was irradiated in the HANARO test reactor at KAERI [2]. The fuel rods were irradiated for 182 effective full power days (EFPDs) and the average burn-up of 2.9 at% was achieved. Fig. 1 shows the X-ray image of the irradiated U-Zr-Ce fuel rod. The fuel slug was cut into more than five segments using low speed saw for four specimens for FCCI tests and one specimen for observation of as-irradiated state of the specimen.

Fig. 1. Transmitted X-ray image of the irradiated U-10Zr -5Ce fuel rod

A special jig for a transient test was designed and manufactured to facilitate easy handling by manipulators in hot-cell. Fig. 2 shows a schematic diagram of the jig. As shown in the figure, the top and the bottom surfaces of the specimens can get in contact with the FC92, and HT9 plates, which enables to induce an inter-diffusion reaction of the fuel slug with T92, FC92, and HT9, simultaneously. The diffusion couple test was conducted at 800 °C for 1 hr to observe microstructure of the specimen, both sides of the dog bone type of the jig was cut and mounted. The microstructures of the fuel slug and clad material were observed using optical microscopy (OM) and scanning electron microscope (SEM) equipped with wavelength dispersive X-ray spectroscopy (WDS) in an electron probe micro analyzer (EPMA, JXA-8320 JEOL).

Fig. 2. Schematics of the jig for fuel cladding chemical interaction.

Experimental

Introduction

Results

Conclusions

Acknowledgement

References