

U-Zr 금속연료와 피복재의 확산반응연구

The Study of Interdiffusion between U-Zr Fuel and Cladding Materials

이종탁, 주근식, 이명호, 강영호

한국원자력연구소

대전광역시 유성구 덕진동 150

요 약

U-23Zr 합금과 cladding 재료인 D9, HT9의 확산쌍을 이용하여 확산반응을 연구하였다. U-23Zr/D9 확산쌍의 반응층은 두껍고 다양한 중간상들이 생성되는 반면에 U-23Zr/HT9 확산쌍의 반응층은 얇고, 생성되는 중간상 수도 적었다. U-23Zr/D9 확산쌍에서는 각진 형태의 석출물이 존재하는 반응층이 생성되었고 이 반응층의 기지조직과 석출물의 조성은 각각 $U_6(Fe, Ni, Cr)$, Zr_2Si 였다. U-23Zr/HT9 확산쌍에서는 Zr rich 층은 UZr_2 가 분해되어 서로 연결되면서 시간경과에 따라 Zr rich layer를 형성한다. U-23Zr 합금내의 Zr rich 상이 확산계면에 있으면 U-23Zr/D9 확산쌍에서는 각진 석출물이 나타나는 반응층이 생성되지 않았고 U-23Zr/HT9 확산쌍에서는 우라늄 확산이 되지 않아 반응층이 생성되지 않았다.

Abstract

Diffusion reaction study between U-23Zr and D9 or HT9 cladding materials were carried out by using diffusion-couple technique. It was observed that thick reaction layers with several intermediate phases were formed in U-23Zr/D9 couple, whereas thin layers with a few intermediate phases couple were formed in U-23/HT9. In the U-23Zr/D9 couple, reaction layer with rectangular shape precipitates was formed. The compositions of the matrix and precipitates of this layer were $U_6(Fe, Ni, Cr)$ and Zr_2Si , respectively. In the U-23Zr/HT9 couple, the UZr_2 phase in the fuel matrix was decomposed and decomposed Zr linked each other to form a Zr rich layer on the diffusion interface. It was evaluated that where Zr rich precipitate was contacted with the diffusion interface, the formation of reaction layer having rectangular precipitates was prevented at the place in U-23Zr/D9 couple and there was no reaction layer due to the blocking of uranium diffusion in U-23Zr/HT9 couple.