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Intermetallic formation and interdiffusion in diffusion couples made of uranium and single crystal iron

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ABSTRACT

We studied the interfacial phase formation and diffusion kinetics in uranium-iron diffusion couples. A comparison was made between polycrystalline uranium (U) bonded with polycrystalline iron (Fe^{P}) and polycrystalline uranium bonded with single crystalline Fe (Fe^{SC}). After thermal annealing at 575^{o}C, 600^{o}C, 625^{o}C and 650^{o}C, respectively, diffusion and microstructures at the interface were characterized by scanning electron microscopy and transmission electron miscopy. The presence of grain boundaries in iron has a significant influence on interface reactions. In comparison with U-Fe^{P} system, interdiffusion coefficients of the U-Fe^{SC} system are significantly lower and were governed by much higher activation energies. Integrated interdiffusion coefficients and intrinsic diffusion coefficients were obtained. The intrinsic diffusion coefficients show faster diffusion of iron atoms in both U_6Fe and UFe_2 intermetallic phases than uranium.

Keywords: FCCI, intermetallic, grain boundaries, interdiffusion coefficients, Kirkendall interface, intrinsic diffusion coefficients

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