15-434

Microstructural Characterisation of Boron Alloyed EUROFER 97 after Neutron Irradiation

M. Klimenkov*, E. Materna-Morris, A. Möslang, H.-C. Schneider

IAM, Karlsruhe Institute of Technology, 71344 Karlsruhe, Germany

Reduced activation feritic-martensitic steels of type EUROFER are promising candidates for fusion structural components. The material shows an excellent resistance to void swelling and a good balance of different physical und mechanical properties. However, a critical effect of low temperature irradiation-induced hardening and embrittlement occurs in the range of 250°C – 350°C. While in fission reactors without B or Ni doping the He to displacement damage ratio is typically 0.1 – 0.3 appm He/dpa it amounts to ~10 appm He/dpa in a first wall of a fusion reactor. Boron alloyed EUROFER was fabricated with different ^{nat}B and ^{10}B content to study the radiation induced mechanical and microstructural changes in the material caused by B-indiced He production. The irradiation was performed up to an accumulated dose of ~16.3 dpa in the HFR (High Flux Reactor, Petten, Netherlands). The achieved He concentration by $^{10}B(n,\alpha)^{7}Li$ generation was <10 appm He, ~80 appm He, ~415 appm He, and ~5800 appm He, respectively.

The material was characterized using scanning electron microscopy (SEM) after mechanical testing and using transmission electron microscopy (TEM). It was found that boron often forms BN inclusions of several hundred nanometer size in the unirradiated material. The presence of these inclusions leads to local inhomogeneities in the distribution of He after irradiation. These formations, known as the “He-eyes”, were detected in the tensile test specimens by SEM investigation. On the other hand TEM investigations in the areas sufficiently far from BN inclusions show the formation of He bubbles in the specimens with 415 and 5800 appm He after irradiation. The irradiation temperature influences the size and spatial distribution of He bubbles. The homogenous distribution of He bubbles was detected in the specimens irradiated at 250°C and 300°C. In the specimens irradiated at 400°C the He bubbles where found to decorate the grain boundaries or dislocation lines. Correlation between the bubbles morphology the fracture behavior and the tensile properties will be shown for the whole temperature range investigated.

**Presenting Author*