Neutron Irradiation Effects on Grain-refined W and W-alloys

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Microstructural data of neutron irradiated Tungsten (W) obtained by neutron irradiated W up to 1.5dpa irradiation in the temperature range of 400-800°C were compiled quantitatively. Nucleation and growth process of these defects were clarified and a qualitative prediction of the damage structure development and hardening of W in fusion reactor environments were made taking into account the solid transmutation effects for the first time.

Powder metallurgically processed pure W and W-alloys were fabricated to improve mechanical properties, recrystallization behavior and radiation resistance of W by grain refining and alloying processes.

Mechanical property and thermal property of the alloys were obtained. Improvement of strength, low temperature embrittlement and recrystallization behavior of the W-alloys compared to pure W were demonstrated.

Trade-off between the thermal conductivity and mechanical property, embrittlement resistance by the structural control must be considered quantitatively to design diverter cooling component. The thermo-mechanical analysis of the diverter block made of the alloys considering thermal diffusivity and recrystallized temperature were performed by finite element analysis.