Contribution ID: **539** Type: **not specified**

P4.204 Development of ductile phase toughened tungsten for fusion plasma facing applications

Thursday, 20 September 2018 11:00 (2 hours)

Tungsten (W) is the leading solid material for fusion plasma facing component (PFC) applications because it has many desirable properties. Future fusion power systems PFCs must tolerate an extremely hostile environment that includes severe heat loads, neutron damage, and surface modifications driven by energetic particle impingement. However, W and most W-alloys exhibit low fracture toughness and a high ductile-to-brittle transition temperature that would render them brittle during operation. Therefore, W-alloys toughened by engineered reinforcement architectures, such as ductile-phase toughening (DPT), are being studied for PFC applications. In DPT, a ductile phase is included in a brittle matrix to increase fracture resistance.

We report studies on W-copper (Cu) and W-nickel (Ni)-iron (Fe) composites that were examined from both a composite development perspective and from a model material standpoint. Notched and un-notched bend specimens with various microstructures were tested at room and elevated temperatures in purified Ar at displacement rates ranging from 0.0002 to 2.0 mm/min. As expected, the general principles of DPT were observed in deformation and fracture of these materials. For example, the Cu phase effectively accumulated very large deformation and failed in a ductile manner in accordance with the behavior expected from its Ashby deformation map.

A finite element microstructural dual-phase model where the constituent phases were finely discretized based on digitized images and described by a continuum damage model was developed. In this approach homogenized meshed regions adjacent to a dual-phase meshed region of an actual bend specimen were created. The model is capable of modelling deformation, cracking, and crack bridging for DPT W-composites or any multiphase composite structure where two or more phases undergo cooperative deformation. We simulated the stress-strain responses and fracture morphologies of W-Cu notched and un-notched specimens subjected to three-point bending and compared predictions to corresponding experimental results.

Presenter: KURTZ, Richard (Pacific Northwest National Laboratory)

Session Classification: P4