DISPLACEMENT RATE DEPENDENCE OF IRRADIATION CREEP AS PREDICTED BY THE PRODUCTION BIAS MODEL - C. H. Woo (Atomic Energy of Canada Limited) and F. A. Garner (Pacific Northwest National Laboratory)

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Extended Abstract

Recently, it has been shown that the non-swelling component of irradiation creep of austenitic stainless steels is relatively independent of temperature but is sensitive to the displacement rate. An earlier model of Lewthwaite and Mosedale anticipated the sensitivity of displacement rate and attributed it to the flux sensitivity of point defect recombination. The point-defect recombination process does not yield the observed temperature dependence, however, although it does predict an inverse dependence of the creep rate on the square root of the displacement rate that was experimentally observed at relatively low temperatures.

The production bias concept of Woo and Singh provides for an improved irradiation creep model. It predicts the correct temperature and dpa rate dependence of the non-swelling-related component of creep, and also provides a good description of the swelling-enhanced component of creep. The dose-rate dependence of the creep and swelling rates occurs as a result of the generation, during cascade damage, of primary clusters, the sink strengths of which are significant compared with those of sinks visible using electron microscopy. The primary clusters act as recombination centers for the single defects. As the dose rate increases, the number density and hence the sink strength of these primary clusters also increases, thus reducing their efficiency. This model leads to a prediction that the creep rate varies as the displacement rate, in close agreement with the observed square root behavior.

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