A Cluster Dynamics Modeling

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Irradiation of metals leads to the formation of point-defects (vacancies and self-interstitials) that usually agglomerate in the form of dislocation loops. Due to the elastic interaction between self-interstitials and dislocations, the loops absorb in most cases more interstitials than vacancies. That is why the loops observed by transmission electron microscopy are almost always interstitial in nature. Nevertheless, vacancy loops have been observed in zirconium following electron or neutron irradiation [1]. Some authors proposed that this unexpected behavior could be accounted for by self-interstitials diffusion anisotropy [2].

Following the approach proposed by Woo [2], the cluster dynamics model presented in [3] that describes point defect agglomeration was extended to the case where diffusion of interstitials is anisotropic. The model was then applied to the microstructural evolution of a thin foil of zirconium irradiated in a high-voltage microscope. The main result is that, due to anisotropic diffusion of interstitials, the crystalline orientation of the foil has considerable influence on the nature (vacancy or interstitial) of the loops that form during irradiation.