A Transmission Electron Microscopy Investigation of Defects Induced in Tungsten Foils by Au and B Ion Irradiation

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Tungsten is a promising candidate for first-wall material in fusion reactors and its use as a plasma-facing material is being investigated in both tokamaks as well as laboratory experiments [1, 2]. In fusion environment tungsten will be exposed to neutron, helium and hydrogen isotope implantation along with the heat flux which will lead to material damage. Irradiation by charged particles such as H, D, T, He, Au, W etc., is employed to surrogate the experiment of high energy and high flux neutron irradiation in tungsten.

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The present work concerns the study of ion mass in meso-scale defects created in tungsten using transmission electron microscopy (TEM) after irradiated by: 1) high energy heavy mass gold (Au of 80 MeV); and 2) low mass boron (B of 10 MeV) ions with a fluence of $1.3 \times 10^{14}/\text{cm}^2$. Prior to irradiation tungsten foil samples of 100 μm thickness (99.96% pure), procured from Princeton Scientific corp. USA, and were recrystallized at 1838K under 10^{-3} mbar base pressure in 200 mbar Ar+8% H_2 environment. Defects created by Au and B ions irradiation in the recrystallized foil were characterized for the types of defect such as defect clusters, dislocation lines, loops etc., and are quantified in terms of dislocation line length, dislocation loop size and their densities using transmission electron microscopy. The small defect clusters in Au irradiated samples and dislocations segments and dislocation loops were observed in B irradiated samples. Furthermore, the Au ion irradiation has led to the formation of dislocation lines density lesser than that of B irradiated foil.

References

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