Surface near Helium damage in materials studied with a high throughput implantation method

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Helium damage in materials is of interest to the nuclear fusion, fission and spallation community. Helium generation in bulk material can cause embrittlements and selling while Helium implantation in surface near areas can lead to blistering, fuzz formation and spalling. All phenomena listed are based on the accumulation of Helium into nanosized bubbles as a function of temperature and external stress states. Studying these phenomena traditionally requires ion beam accelerators and large samples. In this work we introduced nanobeam ion beam implantation methods which enable rapid multi dose ion beam implantation in surface near regions to enable basic scientific studies in single crystal and polycrystal materials such as Cu, Si, W,. The combination of Helium ion beam implantation using the Helium Ion Beam Microscope, Atomic Force Microscopy, Nanoindentation and Transmission Electron Microscope allows to bring insight into the formation of blisters, the linking up of Helium bubbles and the associated deformation and cracking mechanism. We were able to confirm previously posed hypothesis in tungsten blistering as well as show the dose threshold for silicon amorphization.