THE USE OF IN-SITU TRANSMISSION ELECTRON MICROSCOPY TO INVESTIGATE MICROSTRUCTURE EVOLUTION UNDER ION IRRADIATION

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Ion-irradiation produced by accelerators is a useful way to probe materials response to irradiation as it induces radiation damage microstructures that can be similar to those achieved under neutron irradiation without the complications of radioactivity. Because of the higher dose rate it is also a convenient way to reach high levels of radiation damage doses in a reasonable amount of time. When coupled with Transmission Electron Microscopy (TEM) it becomes a powerful tool to gain kinetics information on irradiation induced phenomena because the microstructure evolution of the irradiated material can be followed *in-situ* as the damage proceeds. Given the dynamic nature of irradiation induced phenomena, such direct in-situ observation is in fact often necessary to better understand the mechanisms, kinetics and driving forces of the processes involved. Thus, in situ TEM can be of great help. Indeed, the spatial resolution of TEM makes it an invaluable tool in which one can continuously track the real-time response of the microstructure to ion irradiation, which can help discover and quantify the rate-limiting microscopic processes and mechanisms governing the macroscopic properties.

Henceforward, this presentation will illustrate how in-situ ion irradiation in the TEM has proven successful for studying the basic mechanisms of radiation induced defect formation and evolution as a function of dose and temperature through a couple examples including (i) the investigation of the kinetics of grain growth under ion irradiation in nanocrystalline metals and the resulting thermal-spike based model which was derived to explain the kinetics observed experimentally, and (ii) the evidencing of surprisingly high defect mobility in oxide scales that can develop on Fe based alloys and which may affect the kinetics of corrosion under irradiation.