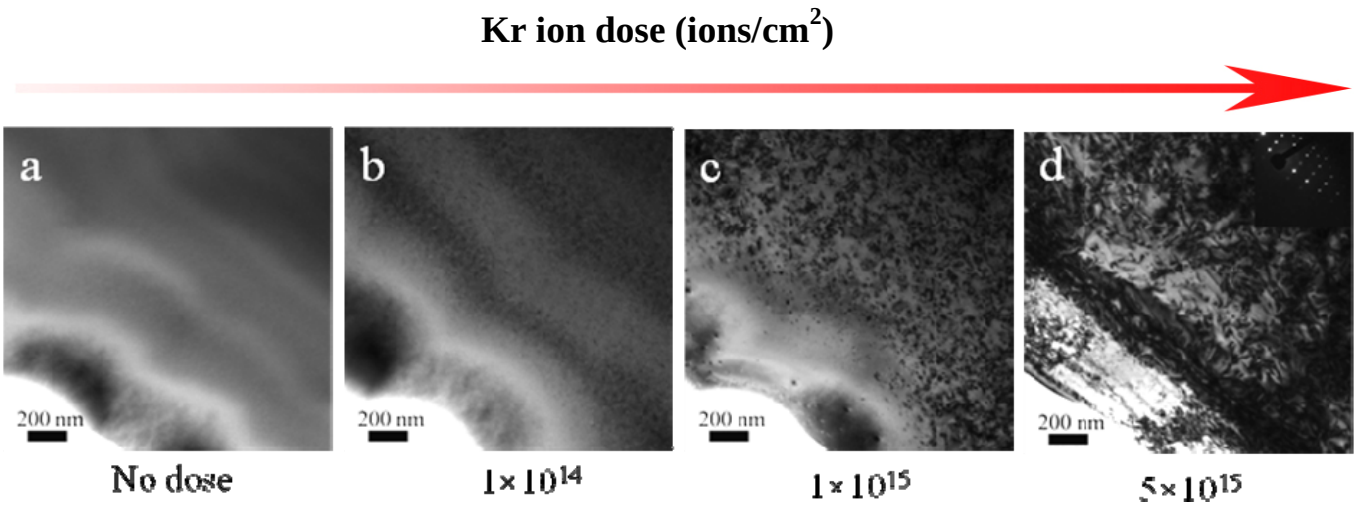
Highlight: *In-situ* Kr irradiation of UO_2 single crystal



EFRC researchers **Lingfeng He** (Post-Doc), **Mahima Gupta** (PhD student), **Clarissa Yablinsky** (Post-Doc), **Todd Allen** (PI) at University of Wisconsin and **Jian Gan** (PI) at Idaho National Laboratory have studied *in-situ* Kr irradiation behavior in UO_2 single crystals at high temperatures. Sequential TEM images showing the nucleation and growth of defects in depleted UO_2 single crystal irradiated with 1 MeV Kr at 800 ^oC at various dose levels: (a) unirradiated, (b) 1×10^{14} ions/cm^2, (c) 1×10^{15} ions/cm^2 (dark field), (d) 5×10^{15} ions/cm^2. The observations were carried out from the [111] direction with $4g_{220}$ reflection. The inset in (d) shows the diffraction pattern. The dislocation loops grew quickly with Kr ion dose at beginning due to accumulation of point defects and some dislocation loops transformed to segments when the dose increased to 1×10^{15} ions/cm^2, and further transformed to dislocation networks at higher doses through coalescence/coarsening mechanisms. The edge areas of the sample under irradiation were relatively defect-free during the whole dose range due to surface sink effects. The diffraction patterns taken after irradiation indicate that the UO_2 specimen still remained crystalline and no amorphization or recrystallization was observed.

The Kr irradiation was carried out with a Tandem implanter, coupled with a 300 kV Hitachi 9000 NAR TEM, at the Intermediate Voltage Electon Microscope (IVEM)-Tandem facility at the Argonne National Laboratory (ANL). Collaborator: Marquis A. Mark. This work has been presented at the TMS 2012 Meeting in Orlando, FL. A manuscript has been submitted to *Journal of Nuclear Materials*.