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P01 - Study of ion probe formation with high current density for micro irradiation techniques

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Impurity segregation is one of the main effects in structural materials in nuclear power engineering under radiation loads. Impurities migrate along the various types of defects in the materials of the reactor facility during operation. It's lead to generate zone with increased concentration of the impurity on the grain boundaries.
Nuclear scanning microprobe has unique capabilities to imitate radiation loads and mapping of the impurity evolution in process of the irradiation step-by-step. The paper discusses the formation proton beam in regime of irradiation microscopic region of the material, which includes several grains. For the purpose of getting uniform dose, the profile of current-density distribution on the target should be close to rectangular. Beam formation regimes which provide maximum current density were considered in order to decrease time for collection necessary dose. Two probe-forming systems based on doublet and separated Russian quadruplet of magnetic quadrupole lenses were discussed. Current density dependence on total current value in the focused beam, when current on FWHM to total current ratio is more than 90% was determined. Total current were varied from 10 to 100nA. Non-uniform distribution of the proton beam of nuclear microprobe, which was measured by method of two slits, was taken into account. Optimized formation beam regimes obtained by numerical simulation were realized into the experiment. The influence of beam energy variation on the spot was considered. Parameters of focused beam was determined by means of calibrated grid scanning and registration secondary electron emission.

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