Experimental phenomena and thermal spike model description of ion tracks in amorphisable inorganic insulators

Toulemonde M, Assmann W, Dufour C, Meftah A, Studer F, Trautmann C
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Experimental investigations of ion tracks produced with energetic heavy projectiles in the electronic energy loss regime are reviewed. Focusing on amorphisable insulators as target material, we present an overview of track phenomena such as the dependence of the track size on energy loss and beam velocity, the critical energy loss for track formation, and damage morphology along the ion tracks. Different characterization techniques for track dimensions are compared including direct, e.g. microscopic observations, as well as quantification of beam-induced damage. In the second part, we present a theoretical description of track formation based on an inelastic thermal spike model. This thermodynamic approach combines the initial size of the energy deposition with the subsequent diffusion process in the electronic subsystem of the target. The track size, resulting from the quench of a molten phase, is determined by the energy density deposited on the atoms around the ion path. Finally, we discuss the general validity of this model and its suitability to describe tracks in non-amorphisable insulators.