Tracks of swift heavy ions in graphite studied by scanning tunneling microscopy

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Tracks of energetic heavy ions on the surface and in the bulk of highly oriented pyrolytic graphite were investigated by scanning tunneling microscopy. Ni, Zn, Xe, and U ions in the MeV to GeV energy range create hillock-like damage zones with diameters between 2 and 3.5 nm, occasionally surrounded by oriented superstructures. Even at highest energy loss, tracks are formed much easier on the sample surface than in the bulk. Tracks on the original surface are generated by electronic energy loss processes above a critical threshold of 7.3±1.5 keV/nm. In a transition regime from 9 to 18 keV/nm, there exists a large discrepancy between the number density of detected tracks and ion fluence. A probability of one is only found for an energy loss above about 18 keV/nm. It is concluded that tracks do not consist of a continuous cylindrical damage trail but of a discontinuous sequence of perturbed zones, in which the lattice is destroyed. Specific material properties and possible recrystallization processes are discussed.