Swift heavy ion tracks in dielectrics and their possible applications for nanotechnology

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Swift heavy ions (SHI) with energies (E_{ion}) higher than 1 MeV per nucleon (MeV/u) and masses higher than 20 nucleons can produce structure and phase transformations in solids in nanometric vicinities of their trajectories. These effects occur, when the electronic stopping power (dE/dx) of the ion overcomes a critical threshold (~ 1 keV/nm). For SHI with $E_{ion} < 1$ MeV/u the elastic energy loss resulting from collisions with target atoms is to low and can not explained the observed structural modifications [1, 2]. The damage structure of SHI tracks in various solids depends on chemical binding, the ion energy E_{ion} and dE/dx, as well as on the irradiation temperature [2 – 5].

SHI effects in solids open new possibilities for nanotechnology due to the nanometric damage scales, the extremely high ratio of the track diameter (10 nm) to the length (100 nm),, and specific structure modifications along the ion path. Developed applications are conductive nanochannels in solids and nanopores in polymers for molecular biology and nanowire technology [5]. New tunable electronic devices are developed for information processing [6]. Damage creation mechanisms and physical limitations for applications are analyzed.

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