Nanoscale Fabrication and Application Using Single GeV Ions

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When high energy heavy ions bombard into the condensed matter material, the projectile's energy is transferred to the target's electrons and nuclei via Coulomb interactions. For MeV to GeV ions most of their energy is deposited within the radius of 1 nm around the ion trajectory via electronic stopping power (dominant) and nuclear stopping power. The dose deposition of a single heavy ion in the target material can reach up to millions of Gray in the nanoscale-confined volume along the ion trajectory. The interaction induces the target atoms excited or ionized along the ion trajectory, and causes lattice damage in crystals, chain break or cross-linking in polymers, or forms nanoscale latent track and color center in many solid materials. High-energy heavy ions have the advantages of high energy loss, long range and low scattering. This report introduces the basics of the beam interaction with materials, and demonstrates the sub-5nm nanowire fabrication using in-air single ion lithography, nanofluidic fabrication and applications of a single-ion hit microbeam.

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