Conductive nanoscopic ion-tracks in diamond-like-carbon

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Highly energetic heavy ions with energies of 1 MeV/nucleon or more (e.g. 350 MeV Au ions) result in material modification in matter. The extremely high local energy deposition along the path leads to a material change within a nanoscopic cylinder of about 10 nm throughout the film thickness (up to 30 μm). In diamond-like carbon the material change results in conducting tracks embedded in the insulating material. This is due to a change in the bond structure to a higher sp^2 bonding content in the tracks and results in a conductivity change of up to four orders of magnitude. This paper discusses the conductivity mechanism in the 10 nm thick wires and presents a study of the conductivity dependence on the sp^3-content in the diamond-like carbon and the used ion species. The conductive tracks are the basis of nanoscopic electronic devices made by irradiation of layered structures.