Conductivity enhancement of ion tracks in tetrahedral amorphous carbon by doping with N, B, Cu and Fe

Krauser J, Nix AK, Gehrke H-G, Hofsäss H, Trautmann C, Weidinger A
Nuclear Instruments and Methods in Physics Research B 272 (2012) 280–283

Conducting ion tracks are formed when high-energy heavy ions (e.g. 1 GeV Au) pass through tetrahedral amorphous carbon (ta-C). These nanowires with a diameter of about 8 nmare embedded in the insulating ta-C matrix and of interest for various nanotechnological applications. Usually the overall conductivity of the tracks and the current/voltage characteristics (Ohmic or non-Ohmic) vary strongly from track to track, even when measured on the same sample, indicating that the track formation is neither complete nor homogeneous. To improve the track conductivity, doping of ta-C with N, B, Cu, or Fe is investigated. Beneficial changes in track conductivity after doping compete with a conductivity increase of the surrounding matrix material. Best results are achieved by incorporation of 1 at.% Cu, while for different reasons, the improvement of the tracks remains moderate for N, B, and Fe doping. Conductivity enhancement of the tracks is assumed to develop during the ion track formation process by an increased number of localized states which contribute to the current transport.