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Lattice location of implanted ions and characterization of implantation-induced damage in Ge

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Due to its high mobility of charge carriers, Ge is seen as an important material in future semiconductor technology. Despite the fact that this elemental semiconductor is known for a long time, the knowledge about the lattice location of impurities, the induced structural and electrical damage of Ge after ion implantation is relatively scarce.

Here we present a study of the lattice location of several impurities after ion implantation, in correlation to the structural and electrical implantation-induced damage. The lattice location of several elements (i.e. Na, Fe, Cu, In, Ag, Sn and Er) was examined in detail with the emission channeling (EC) technique using radioactive isotopes produced at ISOLDE.

The EC-experiments clearly indicate that for most of the investigated elements, the substitutional (S) Ge-position is not the overall preferred lattice site, even after annealing up to 500°C. With the exception of Er, no elements occupy the tetrahedral (T) lattice site. However, a somewhat striking result is that next to the S-site, other 'more exotic'lattice sites such as the bond-centered (BC), split (SP) and anti-bond-centered (AB) site get occupied by some of the implanted ions, before and even after annealing.

The structural quality of implanted Ge samples was also investigated by the Rutherford Backscattering/Channeling (RBS/C) technique as a function of energy, mass and fluence of implanted ions, which helped in explaining the EC results.

Primary author: DECOSTER, Stefan (Instituut voor Kern & Stralingsfysica and INPAC, K.U.Leuven, Belgium)

Co-authors: VANTOMME, André (Instituut voor Kern & Stralingsfysica and INPAC, K.U.Leuven, Belgium); DE VRIES, Bart (Instituut voor Kern & Stralingsfysica and INPAC, K.U.Leuven, Belgium); CORREIA, Joao Guilherme (Instituto Tecnologico e Nuclear, Lisboa, Portugal & CERN-PPE, Geneva, Switzerland); WAHL, Ulrich (Insituto Tecnologico e Nuclear, Lisboa, Portugal)

Presenter: DECOSTER, Stefan (Instituut voor Kern & Stralingsfysica and INPAC, K.U.Leuven, Belgium)

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