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PS3-04 Computer Simulation of Low-Energy Ion Near-Surface Implantation at Channeling Conditions and Different Mass Ratio of Colliding Particles

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Ion implantation has become a very important technique for modifying surface and impurity doping of semiconductors. The ion implantation processes lead to change of a profile of composition and structure of the subsurface layers. Using glancing-angle ion implantation for surface modification rather than conventional near-normal incidence ions allows expanding the energy range up to ~10 keV and has the advantages of reducing damage (such as crater formation) and preferentially removing surface asperities leading to flat surfaces. This is due to the peculiarities of sputtering processes at grazing incidence. Channeling of low-energy ions in metal and semiconductor single crystals offers the opportunity to create the method of local ion implantation in ultrathin film nanotechnology and surface nanoengineering. Therefore, ranges, energy losses and profiles of distribution of low-energy ions channeling in crystals have receive considerable experimental and theoretical interest.

In the present work for revealing of the influence of colliding particles mass ratio (m2/m1 is the mass ratio of target atom and ion, respectively) on the ranges, energy losses and profiles of distribution the channeling of 1÷5keV P+ ions in Si(110) and SiC(110) at normal incidence and 1 keV Be+ and Se+ ions in GaAs(100) at glancing incidence is carried out by computer simulation in binary collision approximation.

The m2/m1 values for P+ ions colliding with Si and C target atoms are equal to 0.9 and 0.39, correspondingly, (m2/m1 <1: inverse mass ratio), for Be+ ions colliding with Ga and As atoms are equal to 7.74 and 8.31, correspondingly, (m2/m1 >1: direct mass ratio) and for Se+ colliding with Ga and As target atoms - to 0.88 and 0.95, correspondingly, (m2/m1 <1: inverse mass ratio). Si, SiC and GaAs crystals have a great importance, because of their use in semiconductor technologies. Especially, silicon carbide exhibits a large band gap, a higher break down field, a higher thermal conductivity, and a higher saturation velocity, compared to widely used silicon. Now β –SiC(110) is widely used as an heterogeneous catalyst.

The (100) surface of GaAs semiconductor is one of the most widely used surface in both homo- and hetero-epitaxial growth for the manufacturing of electronic devices. Implantation of Be and Se into GaAs allows to make the acceptor and donor impurities in this semiconductor. For small crystal depths the approaches which are used in the analytical theory of orientation effects on the large depths, become unacceptable and a computer simulation methods for the channeling process modeling appears to be the most preferable. So, the theoretical investigation of atomic collision processes in crystals caused by particle irradiation and deposition is usually done using computer simulation because real physical conditions (e.g. complicated inter-atomic interaction potential, surfaces, interfaces, defects) can be taken into account much easier than it possible by using analytical methods.

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