TWO-DIMENSIONAL MODELING OF ION IMPLANTATION INDUCED POINT DEFECTS

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The strong influence of point defects (vacancies, interstitials) on the diffusion of dopants is well known and is taken into account in today's simulation programs. Furthermore, it is known that a great amount of point defects is produced by ion implantation. However, no tabulated data is generally available, which could be used as initial condition for the simulation of the annealing step.

We present results of investigations carried out by two-dimensional Monte Carlo simulations. They are based on the "modified Kinchin-Pease" model, which assumes the distribution of vacancies and interstitials to be identical. We have calculated (for the case of boron, phosphorus, arsenic, and antimony implantations into silicon, for energies from 10 keV to 300 keV) two-dimensional distributions as well as one-dimensional distributions together with depth dependent lateral moments (Fig.1 and Fig.2). The latter are particularly useful in tabulated form for a further treatment with a method of moments. The moments method and the construction of distributions under a mask edge can be carried out analogously to the case of dopant distributions, with two exceptions: First, constructing vertical distributions from moments is not feasible, because they do not decay to zero at the surface. However, as is shown in Fig.3, a Gaussian function joined with an ascending exponential function is fairly well suited to fit the profile and can be described by few parameters. Secondly, it can be seen from Fig.2, that the lateral kurtosis assumes dizzy values near the surface, so that the lateral distribution cannot be described by a Gaussian. Fig.4 shows that a Pearson VII distribution can be applied for that purpose.

We have also started investigations about the impact of the ion implantation induced point defects on the diffusion, using the one-dimensional simulation program ZOMBIE. First results show the critical importance of the boundary conditions at the surface and indicate that considering the heating period will probably be necessary.

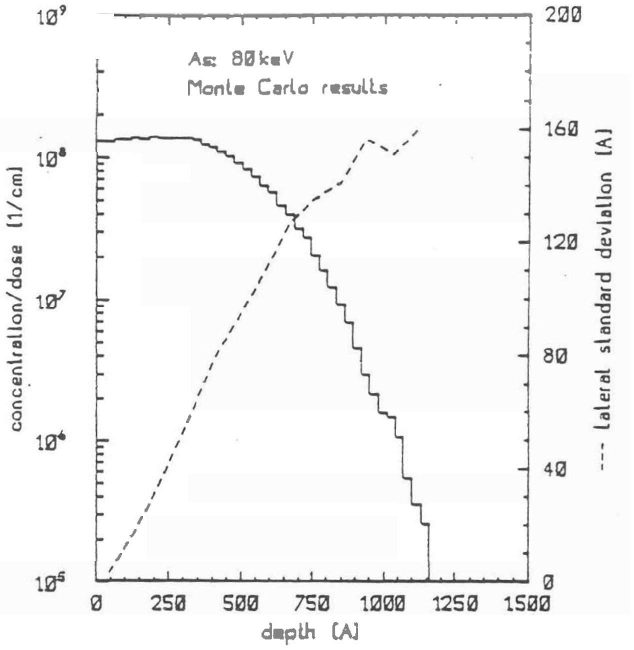

Fig.1: Point defect concentration for arsenic implantation in Si at 80 keV: vertical profile and lateral standard deviation

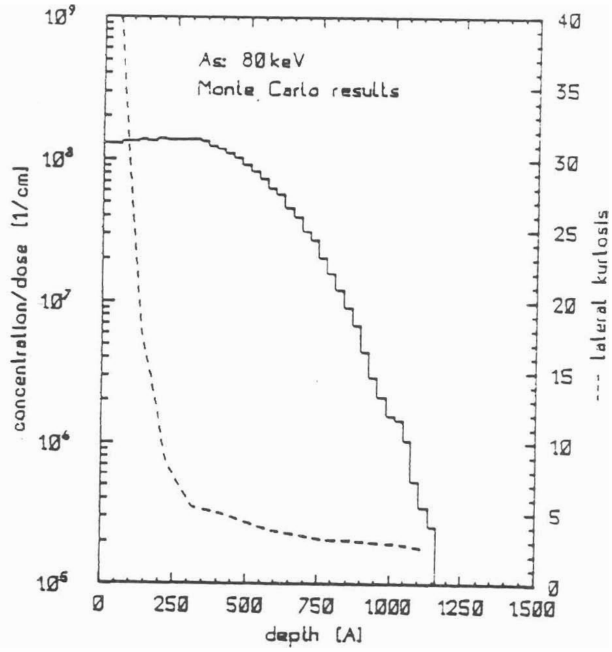

Fig.2: Point defect concentration for arsenic implantation in Si at 80 keV: vertical profile and lateral kurtosis

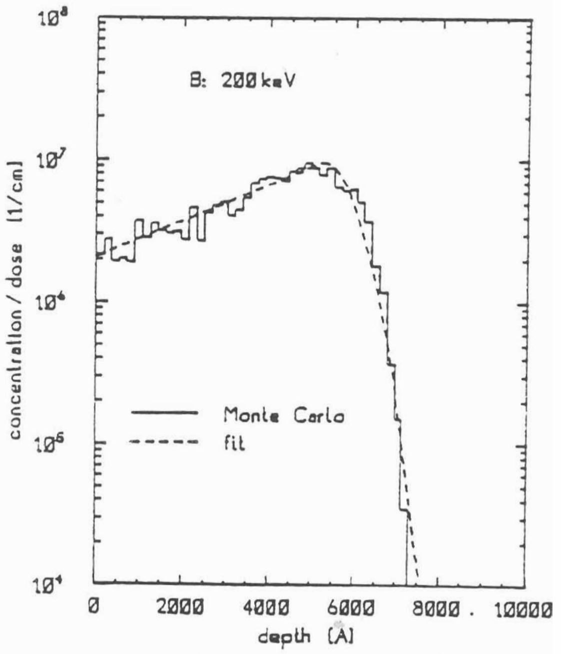

Fig.3: Fitting of the vertical profile by a Gaussian with a joined exponential function

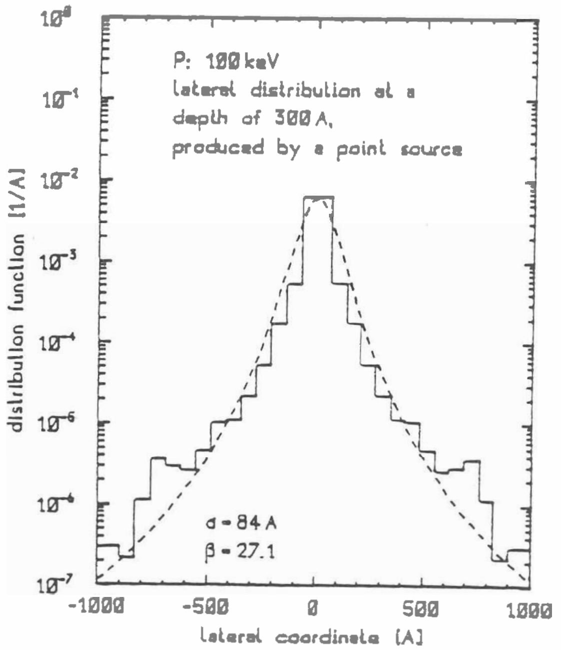

Fig.4: Fitting of the lateral profile by a Pearson VII distribution