Process Simulation at FhG-AIS

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Indroduction

Since the publication of the first one-dimensional process simulation programs [1,2], increasing activities have been carried out in the development and improvement of the physical models involved and the development of more general programs which may be used for simulations in two or three dimensions. In this paper, some aspects of recent work carried out at FhG-AIS are discussed.

Process Models

One main point of the activities of the institute is the development of improved models for ion implantation, diffusion, and oxidation. As the computing times needed for Monte Carlo simulations or Boltzmann transport calculations are in general too big, analytical models for ion implantation profiles are still needed for applications in simulation programs which aim at the simulation of complete process sequences. Problems which need to be covered with these models are the correct profile shapes in various layers, implantation profiles in multilayer structures, and the lateral shape of implantation profiles. For the one dimensional description of ion implantation into silicon, Pearson IV distributions have turned out to be most appropriate [3,4]. For amorphous materials, however, mostly Pearson I or Pearson VI distributions yield the best profile description [5]. Analytical models for implantations into multilayer structures use some approximations to describe the shift of dopant profiles due to the different stopping powers of the layers [6]; the change of the profile shape, e.g. a decrease of profile width in silicon due to implantation through a nitride layer, has not yet been described properly. In Fig. 1, a comparison between measured data and a simulation using the Range Scaling Model [6] are shown. Another important problem in the analytical description of implanation is the depth-dependence of the lateral spread. Here, an improved model which uses the depth-dependent lateral straggling based on mixed vertical and lateral range moments has been developed [5]. The range parameters needed are either obtained from Boltzmann Transport calculations [5] or may be extracted from an optimized technique for delineation of equiconcentration lines [7]. Other recent activities which will be mentioned include work on a new diffusion model for phosphorus [8] and stress-dependent oxidation [9].

Simulation Programs

Since several years, the institute has been developing the one-dimensional process simulation program ICECREM [2,11] and the universal two-dimensional process simulation program COMPOSITE [12,13]. An outline of the present status of these programs is given.

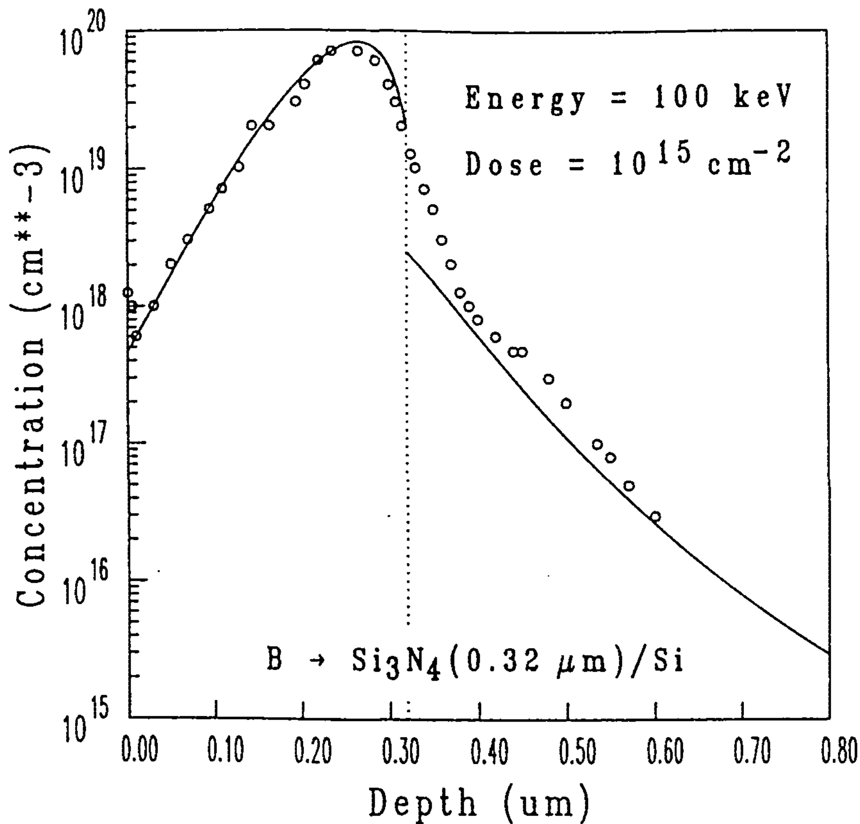

Fig. 1: Comparison between simulation and SIMS measurement for implantation of boron into 0.32 μm Si_3N_4 on top of silicon.

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