

Guest Editorial

ION BEAM TECHNOLOGY IN MATERIALS SCIENCE

Ion beam processing of materials in general and semiconductors in particular, started with ion implantation in semiconductors; first used by Ohl at Bell Labs in 1952 to improve the electrical characteristics of silicon point contact diodes by implanting *H*, *He*, *N* and *Ar* ions. The improvement was obvious but it was caused by surface damage and not the ion implantation. However, in the process, ion implantation had an entry and slowly it became popular among the scientists and the technocrats. Thus, over the last six decades, demands continued for new and improved materials and devices that has pushed ion implanter to expand to ion beam technology. In the semiconductor industry alone, the processes have evolved so much so that in today's world, there are more than 4000 ion implanters in the IC fab lines apart from other ion beam-assisted processing machines. Ion beam deposition techniques, ion beam lithography, ion beam etching, ion beam milling are all ion beam beam-assisted techniques that are being extensively used in semiconductor industries. In this backdrop, it was thought that a compilation of uses of all these techniques together with relevant tools of analysis to serve as a guide to the semiconductor scientists and technologists for a glimpse of the ongoing efforts being made in this direction. Fortunately enough, Indian research is not lagging in use of all these modern day technologies that will be evident as the reader will go from one article to the other of this special volume.

As the time line advanced, the wafer size also has grown in dimension. Now implantation even in 12 inch dia silicon substrate is a reality. This has necessitated the ion beam equipments to evolve for processing the whole wafer (12 inch for example) in a single run. This, in turn has necessitated to address the problems of ion beam focussing, control electronics, uniformity and so on. For a better yield, that can not be compromised in a competitive world, these are the issues needed to be addressed in designing a modern day equipment. Moreover, as device geometry is shrinking day by day, need for lower and lower ion energy is also growing.

Miniaturisation and development of solid state devices

have introduced a whole lot of ion beam-related activities in semiconductor device processing. Parallel to this also have developed many characterisation tools for in-depth knowledge of the overall processing. It is the aim of this special issue to incorporate both of these aspects, viz., processing and characterisation in a single comprehensive volume to give the readers a balanced scenario of the two. In this endeavor where swift heavy ion beam-induced mixing and recrystallisation are presented in two articles, an overview of all such processes going on in Inter University Accelerator Centre (IUAC) at Delhi has been covered in a related article.

In the device area, Microwave Monolithic Integrated Circuits made by ion implantation in *GaAs* has been incorporated. Also, infrared sensors made with strategically important mercury cadmium telluride (MCT) material by ion implantation has been made a part of this issue.

In the characterisation area, techniques like SIMS, BRC Positron Annihilation, etc. have been incorporated as complementary articles.

The age is now of nanoscience. How nanomaterials are being synthesised by ion beam technology have been covered in two articles. Needless to mention that the area of ion beam processing is very vast and no single issue like this can cover the whole spectrum of device processing and characterisation using ion beam technology. So, what is tried to be presented in this volume may be a drop from an ocean.

All the articles mentioned above have used ions from equipments imported from abroad. Efforts are also being made in our country to make ion source indigenously. To give a glimpse of such an effort, one article has been incorporated.

The aim of the present volume is to show how ion beam has invaded all walks of present-day lives. If semiconductor technology is an integral part of the modern society, so is ion beam and technologies associated with it. Hence is the effort to present it.

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