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Editorial

Papers arising from IAEA Coordinated Research Project "Utilization of ion accelerators for studying and modelling of radiation induced defects in semiconductors and insulators" (F11016)

Within the International Atomic Energy Agency (IAEA) Department of Nuclear Sciences and Applications, activities are carried out to assist and advise IAEA Member States in assessing their needs for capacity building, research and development in nuclear sciences. Support is also provided to Member States' activities geared towards deriving benefits in fields such as (i) advanced materials for nuclear applications, (ii) application of accelerators and associated instrumentation, and (iii) nuclear, atomic and molecular data. One of the means that the IAEA uses to deliver its programme is Coordinated Research Projects (CRPs) which are very effective in stimulating international research and scientific interaction among the Member States.

Microelectronic devices and detectors in harsh radiation environments, such as satellites, high energy physics experiments or medical applications, are exposed to high energy radiation. This radiation causes different types of damage to the material structure and electronic properties. Highly energetic ions from accelerators have a prominent role in testing and developing electronic materials and detectors owing to their suitability in introducing controlled amounts of damage by defining the ion fluence with high accuracy, tailoring the damage profile and localizing the damaged region.

This special issue presents some of the key results of a research project coordinated by the Physics Section of the IAEA between 2011 and 2015 under the title: Utilization of ion accelerators for studying and modelling of radiation induced defects in semiconductors and insulators (F11016). This project involved 13 research institutes from 12 Member States and aimed to enhance the capabilities of techniques based on the use of energetic (MeV) ions, both as damaging agents and as probes, to elucidate the mechanisms underlying the radiation-induced degradation of the electronic performances of semiconductor devices.

The focus of the research activity was the development of an experimental protocol for a comprehensive characterization of the effects of radiation damage on semiconductor materials and devices. In order to support this objective a new, optimized theoretical approach to model the effects of radiation induced defects on the electronic properties of semiconductors was founded.

The effectiveness of the protocol was assessed and the interpretative model was validated by the project partners through different types of ion beam irradiation and characterization. These experiments were performed on silicon as a reference semiconducting material, and the methodology was successfully applied to study radiation effects on other materials of high technological interest and with the potential of high radiation tolerance, as silicon carbide and diamond.

The members of this CRP believe that these new results could pave the way towards comprehensive applications of ion beams for creating and characterizing radiation damage and absolute quantification of radiation hardness of semiconductor materials.

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