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Ion beams for the development of radiation resistant semiconductors

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Ion beams are used in a wide range of applications in research and industry including the deliberate modification of functional materials and the characterisation of materials using ion beam analysis techniques. The understanding of ion-solid interactions furthermore allows evaluating the detrimental effects of radiation on materials and devices in different radiation environments. GaN and related semiconductors are currently challenging conventional silicon technology for the next generation of high frequency and high power devices operating in extreme environments such as space. We present recent results demonstrating the extraordinary radiation resistance of GaN upon ion irradiation within a wide energy range. For medium energy (hundreds of keV), GaN shows high amorphisation thresholds, however, the complex defect accumulation processes in the crystal lattice need to be better understood in order to implement ion implantation as a processing tool for nitride electronics. For highly ionising swift heavy ion irradiation (hundreds of MeV), a strong in-track recovery of the crystal damaged during the ion passage keeps permanent damage low. These are promising results for the use of GaN in space. Back on Earth, GaN can find applications in robust detectors for ionising radiation. We will report first results on the development of GaN microwire radiation sensors.

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