Lateral IBIC characterization of a GaAs Schottky diode

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The behavior of the depletion region width of a semi-insulating (SI) gallium arsenide LEC (Liquid Encapsulated Czochralski) Schottky diode has been investigated by lateral ion beam induced charge collection (IBIC) technique.

The justification of this research stems both from the need to know the extension of the active region in GaAs Schottky diodes to be used as radiation detectors in high energy physics experiments or for medical applications as room temperature x/gamma-ray detectors [1] and to further validate the model of Mc.Gregor et al. [2], in which the electric field exhibits a Mott barrier-like distribution.

The diode was fabricated by Alenia SpA on commercially available SI LEC undoped <100> oriented GaAs substrate, 220 μm thick, supplied by Sumitomo. The sample was cleaved along the <110> direction and charge collection efficiency profiles at four different bias voltages were obtained by scanning a focused 2.4 MeV proton beam across the cleaved surface between electrodes.

The profiles are in good agreement with OBIC (Optical Beam Induced Current) and SP (Surface Potential) measurements carried out by Castaldini et al. [3] and they are consistent with the interpretation of Mc. Gregor et al. [2]. At high bias voltage, the deep level capture cross section is enhanced by the electric field, resulting in the formation of a quasineutral region. This region extends from the Schottky contact to a transition region where the neutralisation extinguishes and a positive space charge distribution takes place.

The detector then behaves as a virtual condenser where the Schottky contact and the transition region act as charged plates separated by the quasineutral region of high electric field [3].

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[3] A.Castaldini *et al.*,Phys. Rev. B56 (1997), 9201-9203.