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ACCURATE DETERMINATION OF ARSENIC DEPTH PROFILES IN GaAsN FILMS USING SIMS AND RBS

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GaAsN is a new photonic semiconductor material. The $GaAs_xN_{1-x}$ system does not obey Vegard's law with respect to the As and N composition and therefore it may be possible to achieve a very wide range of band gaps with the materials. The materials can be grown epitaxially on silicon as it is possible to achieve a GaAsN alloy that is lattice matched to silicon. However, a reliable way to accurately determining the As composition in the films is lacking. Since the bandgap and lattice constant both depend on the As concentration, typical techniques for composition determination such as photoluminescence or x-ray diffraction are inadequate. We propose to combine the use of SIMS and RBS to accurately determine the composition depth profiles in GaAsN films.

SIMS is a high precision technique with excellent depth resolution but it cannot provide absolute accuracy without reference materials. RBS provides excellent absolute accuracy but for this type of analysis, it lacks the depth resolution and required precision. In this work, different films with a range of As compositions are analyzed by RBS to serve as SIMS reference samples. The films are subsequently analyzed using SIMS to acquire the AsCs and NCs cluster ion signals. Based on the data and cross calibration, a protocol has been developed to accurately quantify the SIMS As data in unknown GaAsN films.