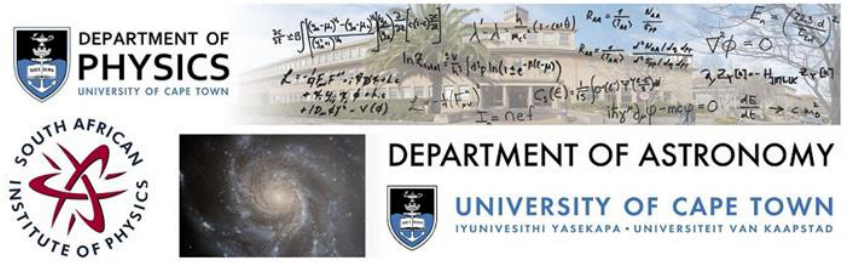

Contribution ID: **476** Type: **Oral Presentation**

Search for dilute magnetism in 3d doped III-Nitrides - Results from Mössbauer Spectroscopy

Friday, 8 July 2016 15:20 (20 minutes)

Abstract content
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ZnO and GaN doped with transitions metals have attracted much attention since the theoretical prediction^[1] that wide band-gap materials are potential dilute magnetic semiconductors with high Curie temperatures (T_c ≥ 300 K), resulting from carrier mediated magnetic interactions due to itinerant holes coupling with localized dopant spins. This motivated our investigations on the site occupancy and magnetic behaviour of Fe ions in III-nitrides using emission Mössbauer spectroscopy (eMS) following the implantation of radioactive Mn⁺ ions at ISOLDE/CERN. Angle dependent measurements performed at room temperature on the 14.4 keV gamma;-rays from the ⁵⁷Fe Mössbauer state (populated from the ⁵⁷Mn beta;⁻ decay) reveal that the majority of the Fe ions are in the 2+ valence state located near substitutional and/or associated with vacancy type defects. eMS experiments conducted over a temperature range of 100-800 K show the presence of magnetically-split sextets in the “wings” of the spectra for GaN and AlN, as observed in ZnO^[2]. The temperature dependence of the sextets relate these spectral features to paramagnetic Fe³⁺ (S=5/2) with rather slow spin-lattice relaxation rates which follow a T² temperature dependence characteristic of a two-phonon Raman process. However, InN did not show the presence of any magnetic structure in the spectra suggesting the absence of high spin Fe³⁺ in the material. These results will be compared to those obtained in 3d-doped ZnO^[3].

[1] Dietl, T. et al: Science, 287 (2000) 1019.
[2] Gunnlaugsson, H. P., et al: Appl. Phys. Lett., 97 (2010) 142501.
[3] Mølholt, T. E. et al: Phys. Scr., T148 (2012) 014006.

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Session Classification: Division for Physics of Condensed Matter and Materials (1)

Track Classification: Track A - Division for Physics of Condensed Matter and Materials