Contribution ID: **27** Type: **not specified**

Observation of Paramagnetic Fe3+ in Mn/Fe implanted Metal Oxides and III-Nitrides

Friday, 7 December 2012 10:00 (45 minutes)

K. Bharuth-Ram 1, H. P. Gunnlaugson 2, T E Mølholt 3, D. Naidoo 4, R. Mantovan 5, H. Masenda 4, M. Ncube 4, K. Johnston 6, W. Dlamini 1, R. Sielemann 7, H. P. Gíslason 3, G.Langouche 8,S. Ólafsson 3, G. Weyer 2, and the ISOLDE Collaboration 6

1 School of Physics, University of KwaZulu-Natal, South Africa; 2 Institute of Physics and Astronomy, Aarhus University, Aarhus, Denmark; 3 Science Institute, University of Iceland, Reykjavík, Iceland; 4 School of Physics, University of the Witwatersrand, South Africa; 5 Laboratorio MDM IMM-CNR, Agrate Brianza (MB), Italy; 6 EP Division, ISOLDE/CERN, Switzerland; 7 Helmholtz Zentrum – Berlin, Germany; 8 Department of Physics, KU - Leuven, Leuven, Belgium.

Theoretical prediction of ferromagnetic behaviour above room temperature in ZnO (and GaN) doped with dilute concentrations (6 – 8%) of transition metal (TM) ions has excited considerable interest because of their potential as semiconductor-compatible magnetic components for spintronic applications. Observation of room temperature ferromagnetism (RTFM) in ZnO doped with TM ions have been reported, however, no clarity exists on the origin of the observed magnetism, which has been attributed to dopant-defect complexes, unintentional precipitation, or to the formation of secondary magnetic phases. The Mössbauer Collabo-ration at ISOLDE/CERN has applied 57Fe emission Mössbauer spectroscopy following the implantation of 57Mn*, to study the nature of the magnetism in ZnO and other metal oxides and III-nitrides. Radioactive beams of 57Mn+ (T½ = 1.5 min) ions are produced at the ISOLDE facility following fission in a UC2 target induced by 1.4 GeV protons and multi-stage element selective laser ionization. High purity beams of intensity of ~3×108 ions/s were implanted with 40-60 keV energy and to fluences below 1012 ions/cm2 into commercially available single crystal samples. The Mössbauer spectra obtained on-line after implantation into ZnO single crystals show magnetic hyperfine sextets originating from Fe in the high-spin Fe3+ state. Measurements in an external magnetic field show that these sextets are not due to ferromagnetic Fe but to paramagnetic substitutional Fe3+ with unusually long relaxation times. Similar high-spin Fe3+ paramagnetic sextet structure is also observed in MgO and alpha-Al2O3. Results obtained for ZnO, alpha-Al2O3 and MgO, as well as preliminary results for GaN, AlN and InN, will be presented.

Presentation Type

Oral

Primary authors: Dr NAIDOO, Deena (University of the Witwatersrand, South Africa); Prof. WEYER, Gerd (University of Aarhus, Denmark); Prof. LANGOUCHE, Guido (KU-Leuven, Belgium); Prof. GÍSLASON, Haflidi (University of Iceland, Iceland); Mr MASENDA, Hilary (University of the Witwatersrand, South Africa); Dr JOHNSTON, Karl (Physics Division, ISOLDE, CERN, Geneva); Prof. BHARUTH-RAM, Krishanlal (University of KwaZulu-Natal, South Africa); Mr NCUBE, Mehluli (University of the Witwatersrand, South Africa); Prof. GUNNLAUGSSON, Palle (University of Aarhus, Denmark); Dr SIELEMANN, Rainer (Helmholtz Zentrum - Berlin, Germany); Dr MANTOVAN, Roberto (Laboratorio Nazionale MDM CNR-INFM, Italy); Prof. ÓLAFSSON, Sveinn (University of Iceland, Iceland); Mr MOLHOLT, Torben (University of Iceland, Iceland); Ms DLAMINI, Wendy (Univesrity of KwaZulu-Natal, South Africa)

Presenter: Prof. BHARUTH-RAM, Krishanlal (University of KwaZulu-Natal, South Africa)