

An overview of emission ^{57}Fe Mössbauer spectroscopy investigations in metal oxides

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Oxides, in particular ZnO doped with 3d-metal impurities has been of scientific interest since the suggestion that it could be a magnetic semiconductor with applications in spintronics [1]. ^{57}Fe Mössbauer spectroscopy is a powerful method to determine the properties of the probe atoms, giving simultaneously information on the charge/spin state, site symmetry and on magnetic interactions. In this presentation, we report on emission ^{57}Fe Mössbauer spectroscopy measurements following implantation of dilute $^{57}\text{Mn}^+$ ions ($<5 \times 10^{12} \text{ cm}^{-2}$) at ISOLDE/CERN in ZnO, $\alpha\text{-Al}_2\text{O}_3$ and MgO single crystal samples held at temperatures between 77-800 K in an implantation chamber.

The spectra obtained for these materials are characterized by a magnetic structure on the wings of the spectra with the central region dominated by implanted ions occupying a combination of different lattice sites either due to interstitial Fe, substitutional Fe or probe atoms in amorphous surroundings due to the implantation damage. The magnetic hyperfine pattern of the spectra in each oxide is assigned to Fe^{3+} ions in a paramagnetic state with unusually long relaxation times observable at the highest measured temperatures [2]. This report will focus on a comparison of the derived hyperfine parameters, assigned charge states, extracted spin-lattice relaxation rates and observed annealing stages obtained for these materials. The results obtained from this study will be also compared with data obtained from ^{57}Co and ^{57}Fe implantations.

References

- [1] Dietl et al., Science, 287 (2000) 1019
- [2] Gunnlaugsson et al., Appl. Phys. Lett., 97 (2010) 142501

Primary author: Dr NAIDOO, Deena (School of Physics, University of the Witwatersrand, Private Bag 3, WITS, 2050)

Co-authors: ISOLDE, Collaboration (PH Dept, ISOLDE/CERN, 1211 Geneva 23, Switzerland); Prof. LANGOUCHE, G. (Instituut voor Kern-en Stralings fysika, University of Leuven, 3001 Leuven, Belgium); Prof. WEYER, G. (Department of Physics and Astronomy, Aarhus University, Ny Munkegade 120, 8000 Aarhus, Denmark); Prof. GUNNLAUGSSON, H. (Department of Physics and Astronomy, Aarhus University, Ny Munkegade 120, 8000 Aarhus, Denmark); Mr MASENDA, H. (School of Physics, University of the Witwatersrand, Private Bag 3, WITS, 2050); Prof. BHARUTH-RAM, K. (School of Physics, Durban University of Technology, Durban 4000, South Africa); Dr JOHNSTON, K. (PH Dept, ISOLDE/CERN, 1211 Geneva 23, Switzerland); Dr MANTOVAN, R. (Laboratorio MDM, IMM-CNR, Via Olivetti 2, 20864 Agrate Brianza (MB), Italy); Dr ÓLAFSSON, S. (Science Institute, University of Iceland, Dunhaga 3, 107 Reykjavík, Iceland); MØLHOLT, T.E. (Science Institute, University of Iceland, Dunhaga 3, 107 Reykjavík, Iceland)

Presenter: Dr NAIDOO, Deena (School of Physics, University of the Witwatersrand, Private Bag 3, WITS, 2050)

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