

# SPECTROSCOPIC INVESTIGATION OF CATION CONFIGURATION STATE OF SPINEL FERRITE THIN FILMS

V. Zviagin<sup>a</sup>, P. Huth<sup>b</sup>, C. Sturm<sup>a</sup>, M. Bonholzer<sup>a</sup>, J. Lenzner<sup>a</sup>, A. Setzer<sup>a</sup>, R. Denecke<sup>b</sup>, P. Esquinazi<sup>a</sup>, M. Grundmann<sup>a</sup> and R. Schmidt-Grund<sup>a</sup>

<sup>a</sup>Felix-Bloch-Institut für Festkörperphysik, Linnéstr. 5, Universität Leipzig, Germany

<sup>b</sup>Wilhelm-Ostwald-Institut für Physikalische und Theoretische Chemie, Linnéstr. 2, Universität Leipzig, Germany

We present a systematic study of cation configurations of spinel type  $\text{ZnFe}_2\text{O}_4$  (ZFO) and  $\text{Zn}_x\text{Fe}_{3-x}\text{O}_4$  thin films fabricated by pulsed laser deposition. Electronic transitions assigned in the model dielectric function (MDF) correspond to  $\text{Fe}^{2+}$  interband d-d band and  $\text{O}^{2-}$  anion 2p to  $\text{Fe}^{3+}$  cation 4s and 3d band optical transitions [1]. Taking into account the contribution of each optical transition to the MDF, we have estimated the cation concentration ratio corresponding to the disordered state of the normal spinel configuration, and have compared it to the room temperature magnetization saturation of ZFO films before and after annealing in oxygen and argon atmospheres at temperatures to  $375^\circ\text{C}$ , (see Fig.1 a). Surface sensitive XPS Fe 2p and 3p core level analysis generally follows the trend, but shows also a deviation in the divalent and trivalent cation ratio as obtained from the bulk MDF for the  $\text{Zn}_x\text{Fe}_{3-x}\text{O}_4$  films, (Fig. 1 b). Two competing exchange interactions, AFM oxygen mediated super-exchange and FM double-exchange, were determined as a function of annealing temperature in ZFO and of the Zn/Fe ratio in  $\text{Zn}_x\text{Fe}_{3-x}\text{O}_4$  films. The results clarify their role in weakening the total ferrimagnetic response.

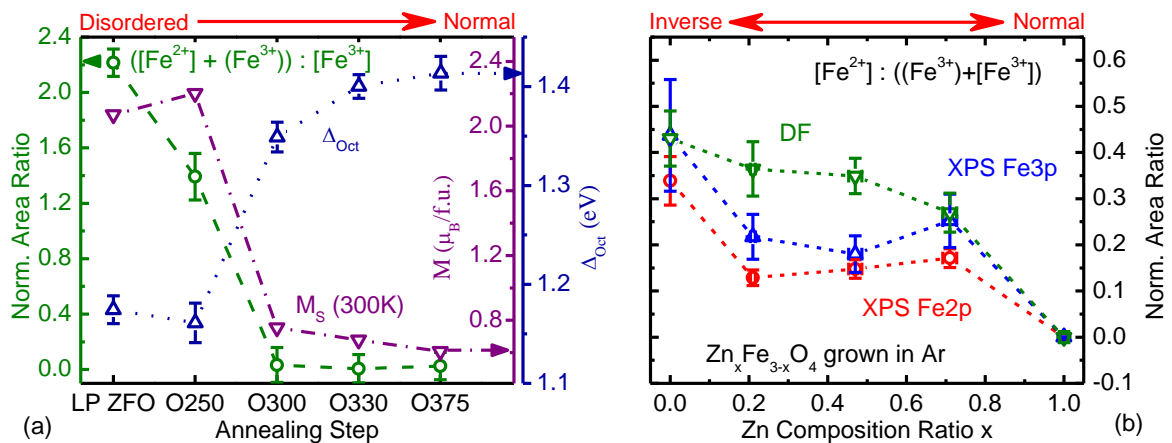


Fig. 1. (a) Area ratio of transitions involving divalent and trivalent Fe cations, representing disorder in a normal spinel structure, octahedral crystal field parameter and room temperature magnetization saturation as a function of annealing step in oxygen atmosphere. (b) Normalized area ratio of divalent and trivalent Fe cation contributions obtained from transitions in the DF and XPS Fe 2p and 3p core levels as a function of Zn composition ratio.

Keywords: Dielectric Function; Ferrimagnetic Material; Spinel Ferrites

## References

[1] V. Zviagin, Y. Kumar, I. Lorite, P. Esquinazi, M. Grundmann, R. Schmidt-Grund, Appl. Phys. Lett. 108 (2016) 131901.