VERWEY TRANSITION IN Fe_3O_4 THIN FILMS: EFFECT OF SUBSTRATE TEMPERATURE

M. Bohra[1,2], S. Prasad[2], N.Venkataramani[2]
[1]*LSG2M, UMR 7584 CNRS-INPL Ecole des Mines, F-54042 Nancy, France*
[2]*IIT-Bombay, India*

Fe_3O_4 with spinel structure is a promising material for spintronic devices because of its half metallic nature and high Curie temperature of 853 K. Additionally, Fe_3O_4 shows curious metal-insulator transition at temperature of T_v = 120 K, named as Verwey transition, where magnetite transforms from cubic to monoclinic crystal structure due to freezing of electron hopping. [1-3] Observation of the Verwey transition by means of magnetic study is an interesting way to deduce the purity of films since this transition is signature of Fe_3O_4. Fe_3O_4 thin films were deposited by PLD at various substrate temperatures (T_s) on fused quartz substrates. The study showed that the substrate temperature play an important role in determining the composition and structural properties of the films. Films with ($\ell\ell$0) and ($\ell\ell\ell$) orientations could be achived by varying T_s. The $4\pi M_s$ value does not show monotonous increase with T_s but goes through a maximum value for T_s of 350° C. Temperature dependence of magnetization (M-T) study shows that, as T_s increases from RT to 850° C, the position of Verwey transition temperature changes from 70 K to 120 K and then to spread over a wider temperature range. This raises the possibility of controlling the properties in Fe_3O_4 films by varying the T_s and higher T_s is essential for the application to spin-electronics device. The origin of the Verwey transition and its shift will be discussed on the basis of these results.

[1] A. Yanase, K. Siratori, J. Phys. Soc. Jap. **53**, 312 (1984)
[2] G.Hu and Y.Suzuki, Phys. Rev. Lett. **89**, 276601 (2002)
[3] L. R. Bickford, Jr., Rev. Mod. Phys. **25**, 75 (1953)