Electrical conductivity of cobalt oxide films deposited by DC sputtering onto different substrates

J. C. Angelico[1,2,*,#], N. F. Azevedo Neto[1], J. H. Dias da Silva[1]

[1]São Paulo State University – UNESP, Bauru – SP, Brazil
[2] Paulista University – UNIP, Bauru – SP, Brazil

[#]Corresponding author: jcangelico@gmail.com

In nanocrystalline materials the electrical properties are strongly modified in the interfaces of nanocrystals due to the interruption of the crystal periodicity. In the interfacial regions a large surface density of dangling bonds and modified surface structure are expected, reducing the average electronic mobility in the material. This structural disorder implies highly complex systems and, therefore, the existence of several concurrent mechanisms in the transportation of electrical charge [1]. In this report, nanocrystalline cobalt oxide films were produced by using the DC magnetron sputtering technique. Parallel Al electrical contacts, with 6 mm length and 1 mm separation, were deposited by thermal evaporation, in vacuum, along the free film surface. Under vacuum of the order of 10^{-5} Torr were analyzed the electrical conductivity, as a function of the temperature (σ x T), in continuous current, for samples deposited onto silica and Sapphire (C-plane) substrates. X-ray diffraction measurements indicated that films exhibit predominantly Co_3O_4 phase with spinel structure. The films grown on sapphire substrates presented better crystalline structure. At 300 K, the films deposited onto silica, presented electrical conductivity of 6.00 x 10^{-1} S/m, while the films deposited onto sapphire presented electrical conductivity of 7.70 x 10^{-2} S/m. The difference between the conductivities decreased slightly as the temperature was reduced to 100 K. At this temperature the conductivities for films grown onto silica and sapphire were, respectively, 9.00 x 10^{-4} S/m and 1.90 x 10^{-4} S/m. The higher conductivity of the films grown on silica can be attributed to the higher density of states in the gap when compared to the films grown onto sapphire substrates that presented better crystalline arrangement.

Acknowledgments: LNNano and FAPESP (2014/204710)

Reference:

[1] J. C. Angelico, A. L. J. Pereira, L. B. de Arruda, J. H. D. da Silva. Jour. Of Alloys and Compounds, 630 (2015) 78-83.