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Influence of Fabrication Parameters on Crystallization, Microstructure and Surface Composition of NbN Thin Films Deposited by RF Magnetron Sputtering.

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Abstract –.

Due to their mechanical properties, their high fusion point and their thermal and chemical stability, transition metal nitrides present a great variety of applications spanning from hard coatings to electromagnetic radiation detectors. In particular, NbN has been studied as a potentially useful material for low temperature electronics, for instance, in superconductor tunnel junctions [1, 2]. Likewise, the possibility of using NbN as cathode in vacuum microelectronic devices [3] has been also considered. Other nitrides such as TiN and TaN have been used as diffusion barriers to prevent copper diffusion into silicon.

In this work, NbN_x thin films have been grown on glass by rf magnetron sputtering using a δ-NbN (99.99%) target. In particular, the influence of certain fabrication parameters (substrate temperature, power supplied to the target or additional N_2 flux in the preparation chamber) on the crystallization, microstructure and surface composition of the deposited films has been examined. The films have been characterized by X-Ray diffraction (XRD) at grazing angle in the θ-2θ configuration, scanning electron microscopy (SEM), transmission electron microscopy (TEM) and X-Ray photoelectron spectroscopy (XPS). XRD results show that films grown at a substrate temperature of 573 K and a power supplied to the target of 300 W present the same crystalline structure of the substrate, while films grown under these temperature and power conditions plus additional presence of N_2 during fabrication show a preferential orientation along the (200) plane of the face-centered cubic (fcc) δ-NbN structure (figure 1). TEM results show that the films obtained grow in a fcc structure, corroborating the XRD results. SEM results indicate that the films present columnar growth showing a high homogeneity and having an average thickness of 0.7 μm. XPS (figure 2) shows a complex surface composition of the films most external 5 nm, indicating the presence of niobium nitride (NbN_x), niobium oxy-nitride (NbN_xO_y) and niobium oxide (Nb_2O_5).

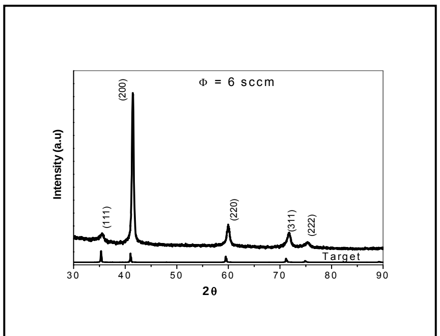

Figure 1: Grazing angle (2°) XRD pattern of a δ-NbN film grown at 553 K, 300 W and 6 sccm nitrogen flux. The XRD pattern of the target is included as a reference.

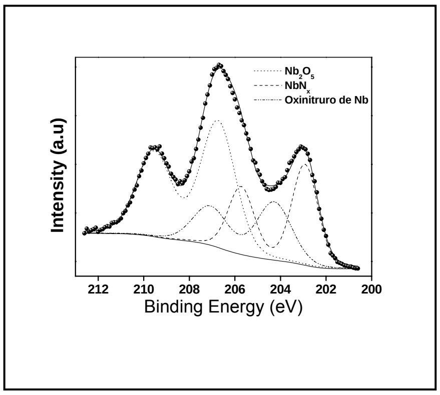

Figure 2. Nb 3d XPS narrow scan spectrum of a NbN film grown in a nitrogen rich atmosphere.

References

[1] T. Ishigaro, K. Matsushima,K. Hamasaki, J. Appl. Phys. **73**, 1151 (1993).
[2] Z. Wang, A. Kawakami, Y. Uzawa, B. Komiyama. J. Appl. Phys, **78**, 7837 (1996) .
[3] Y. Gotoh, M. Nagao, T. Ura, H. Tsuji, J. Ishikawa, Nucl. Instr. Meth. Phys. Res. B Beam Interact. Matter. Atoms 1 (**48**) 925 (1999).