

**ELECTRICAL AND OPTICAL PROPERTIES OF $Ti_xO_y:Nb$ THIN FILMS DEPOSITED BY GRID-ASSISTED
MAGNETRON SPUTTERING WITH PULSED BIAS**

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Titanium oxide films doped with niobium were deposited by sputtering, using triode magnetron sputtering technique. In this work, the $Ti_xO_y:Nb$ films (as deposited) showed properties of TCO films, that is, it displays an interesting combination of properties: transparency and electrical conductivity. Films containing different ratios of Nb/Ti, and deposited under different substrate bias, were characterized by the following techniques: optical transmittance and reflectance measurements, Hall resistivity, x-ray diffraction (XRD) and energy dispersive fluorescence of x-ray (EDX). It was not observed any peak of niobium oxide in the XRD pattern of $Ti_xO_y:Nb$, indicating that the Nb atoms are in substitutional sites of Ti structure. Optical transmittance and reflectance measurements associated to computational simulations, using the Tauc-Lorentz model, allow us to obtain intrinsic optical properties such as refractive index and extinction coefficient. The transmittance depends on the percentage of niobium and type of substrate bias (“pulsed bias” or “DC bias”). Results of transmittance measurements of $Ti_xO_y:Nb$ films (as deposited, without annealing) reached values up to 60%. Electrical resistivity measurements using the method of four points probe through van der Pauw technique indicate values around $10^{-2} \Omega\text{cm}$. The electrical properties were also calculated by using optical parameters. It indicates a reduction in the resistivity due to the Nb incorporation and pulsed bias.

References

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