

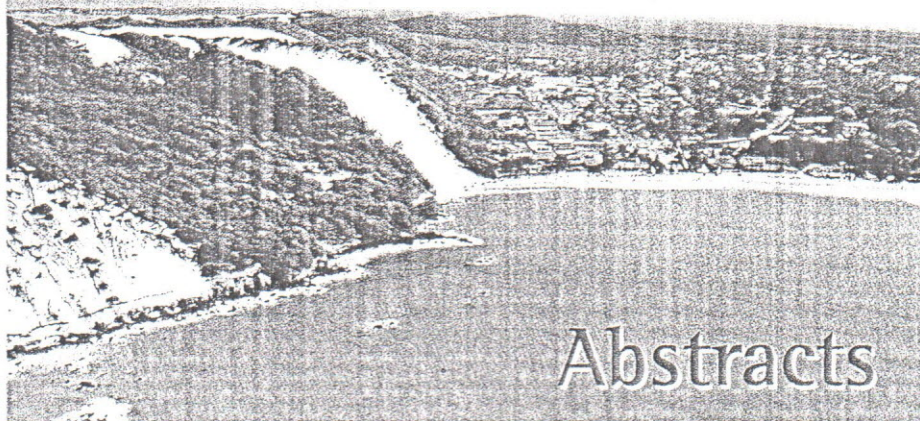
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Abstracts

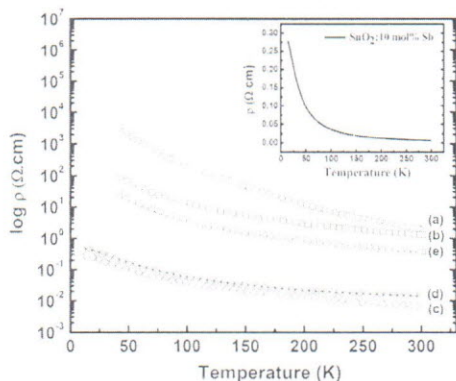
## Electrical Characterization of SnO<sub>2</sub>:Sb Ultrathin Films obtained by Controlled Thickness Deposition

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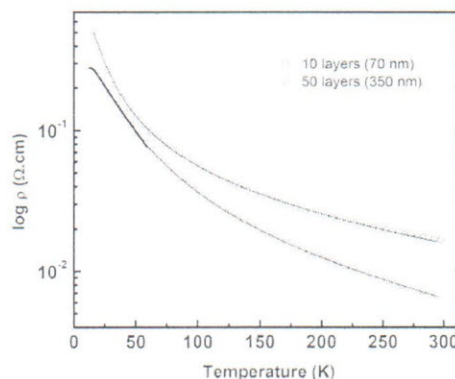
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**Abstract** – A representative study is reported on the electrical properties of SnO<sub>2</sub>:Sb ultrathin films (thickness of 40 - 70 nm) produced by a deposition method based on colloidal suspensions of 3 - 5 nm crystalline oxides. The results revealed the films' electrical behavior in a range of 10 -- 300 K, showing a strong dependence on dopant incorporation, with minimum resistivity values in 10 mol% of Sb content. All the samples displayed semiconductor behavior, but the transport mechanism showed a strong dependence on thickness. In thicker films, the mechanism proved to be an intermediary system, with thermally activated and hopping features.

In recent years, considerable effort has been dedicated to research on SnO<sub>2</sub>:Sb system due its potential application as a transparent conductor. One of the main goals is the enhancement of the electrical and optical properties of SnO<sub>2</sub>:Sb films by reducing and/or controlling the particle size, deposition and annealing conditions<sup>1</sup>. The literature reports this system as semiconductor-like with resistivity values around 10<sup>-3</sup> Ω.cm at room temperature. In low temperatures (until 80K), an activated conduction mechanism governed by variable-range hopping (VHR) was proposed<sup>1</sup>. In this work the electrical properties of SnO<sub>2</sub>:Sb ultrathin films (thickness of 40 - 70 nm) produced by a deposition method based on colloidal suspensions of 3 - 5 nm crystalline oxides were investigated. The resistivity behavior was analyzed (Fig. 1), showing an optimal behavior in 10% Sb mol content. The dominant electrical transport mechanism was analyzed in samples with 10% mol Sb (Fig 2). The resistivity data versus temperature were fitted to a generalized model<sup>2</sup> for VHR, showing a phenomenological combination of VHR and thermally activated mechanism. The adjustment suggests the existence of a particular conduction mechanism probably associated with the nature of the component nanoparticles. The localization length was calculated as ~ 1.9 nm in 70 - nm film (10 - 60 K), which is comparable with the Bohr radius for SnO<sub>2</sub>, thus confirming the VHR as the dominant mechanism at low temperatures (< 60 K)



**Figure 1:** Resistivity data for different Sb molar concentration: a) 0% mol Sb (SnO<sub>2</sub> pure); b) 5%; c) 0%; d) 14%; e) 18%.



**Figure 2:** Resistivity data for different thickness in 10% mol Sb concentration. The lines represent the fits for each sample.

### References

- [1] Giraldi, T.R. et. al. J. Nanosci. Nanotechnol. **2006**, 6, 3849
- [2] Mott, N.F. Metal-Insulator Transitions. **1974**, Taylor and Francis, London.