

**TRANSPARENT CONDUCTING OXIDE FILMS
FOR
SIS SOLAR CELLS**

by

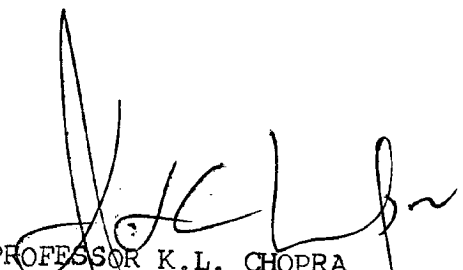
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*Thesis Submitted
In fulfilment of the requirements
of the degree of
DOCTOR OF PHILOSOPHY*

to the

**INDIAN INSTITUTE OF TECHNOLOGY, DELHI
JULY, 1981**

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ACKNOWLEDGEMENT

I consider it as a great privilege to have worked under Prof. K.L. Chopra who introduced me into this field and afforded excellent facilities and guidance to carry out research work. I am sincerely thankful to Dr. A. Banerjee and Dr. V. Dutta who had shown very keen interest in my work. Their **critical** and objective analysis throughout the course of my work were very helpful.

My work has been immensely facilitated by the ready cooperation extended by my colleagues of Thin Film Laboratory. In particular, I am thankful to Dr. P.J. George, Mr. S. Rajagopalan, Dr. D.K. Pandya and Dr. S.R. Das whose advice and suggestions were of great benefit in course of my work. I also acknowledge with thanks Mr. K.S. Harshvardhan and Mr. K. Chidambaram for the help rendered to me in the compilation of the Thesis.

I am also thankful to Mr. V.D. Arora and Mr. N.S. Gupta for their help in transmission electron microscopy and **efficient** drafting, respectively. The research fellowship of I.I.T. is also gratefully acknowledged.

Above all, I am greatly indebted to my parents for their unstinted co-operation and encouragement at home in the pursuit of my work.

Finally, it is a pleasure to thank Mr. Anil K. Maithani for his neat and efficient typing of the Thesis.

E. Shanthi

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ABSTRACT

In the present work we have carried out a systematic and detailed study of transparent conducting oxide films, namely, tin oxide and zinc oxide, prepared by spray pyrolysis.

Tin oxide films have been doped with number of dopants, such as, Sb, F and (Sb + F) and their effects on the different properties of the films have been investigated. Auger analysis and depth profile have been carried out to determine the concentration of the dopant and the concentration gradient throughout the thickness of the films.

Structural studies have been carried out using transmission electron microscope. Reflection diffraction study of doped films reveals that these films exhibit preferred orientation. The surface topography of these films has been examined using scanning electron microscope. The effects of substrate temperature and doping, on grain size and surface morphology of the films, have been studied.

Sheet resistance as low as $9.2 \text{ ohm}/\square$ with high optical transmission ($> 80\%$) and high infrared reflection ($\sim 90\%$) have been obtained in F-doped tin oxide films. The temperature dependence of electron mobility has been analysed to establish the electron conduction mechanism. The electrical properties of the films are profoundly modified by the nature and concentration of the dopants used. The electrical properties

of Sb-, F- and (Sb+F) - doped tin oxide films have been studied, in detail, to determine the role of impurities. The annealing characteristics of undoped and antimony - doped tin oxide films, upto temperatures of 400 °C, in various ambients have been carried out with a view to ascertain the role of oxygen on the electrical properties.

Variation in optical properties with dopant concentration has been studied in the entire ultraviolet to infrared region. Fundamental absorption edge occurs in uv range. Large Moss-Burstein shift has been observed in these films. Optical properties near the plasma edge occurring near the infrared range have been analysed using Drude theory. The dependence of effective mass has been explained on the basis of nonparabolicity of the conduction band. The shift in the Fermi energy, calculated on the basis of energy dependent effective mass, is consistent with the measured shift in the absorption edge.

The effect of the dopants on the different properties of the ZnO films has also been the subject of detailed investigation. Resistivity as low as 3×10^{-3} ohm cm. with optical transmission of 80-90 % has been obtained in vacuum/hydrogen-annealed Al-doped ZnO films. The cause for the variation in electrical properties of the films on annealing in different ambients has also been examined.

Fluorine-doped tin oxide films, prepared by spray pyrolysis technique, has been used to fabricate F-doped tin oxide/n-Si solar cells. These cells are characterised by I-V, C-V and spectral response measurements.

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