A STUDY OF CONDUCTIVITY AND DIELECTRIC BEHAVIOR OF SOME SILVER SUPERIONIC CONDUCTORS

by

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fulfilment of the requirements
of the degree of
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TO

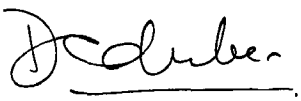
MY

PARENTS

CERTIFICATE

This is to certify that thesis entitled, "A Study of Conductivity and Dielectric Behavior of Some Silver Superionic Conductors", being submitted by Mr. Ashok K. Saraswat to the Indian Institute of Technology, Delhi, for the award of the degree of Doctor of Philosophy in Physics is a record bonafide research work carried out by him. Mr. Ashok K. Saraswat has worked under my guidance and supervision and has fulfilled the requirements for the submission of this thesis.

The results obtained in this thesis have not been submitted, in part or full, to any other university or institution for the award of any degree or diploma.



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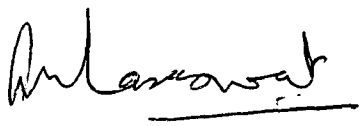

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OBJECTIVE OF THE THESIS

Importance of solid electrolytes for industrial applications is well known. Most promising materials for the purpose are silver compounds, mainly because of low co-ordination number and flexible stereochemistry. Despite of the fact that lot of work has been reported on fast ion conductors, the physical processes involved in them are not yet properly understood. It is becoming clear that a systematic study of electrical conduction and charge transport in these materials is necessary if their practical use is to be made. In view of the above, objective of the thesis was to systematically examine the electrical properties of two carefully selected materials :

(i) Silver iodide (AgI)

(ii) Silver iodide - Silver orthophosphate binary system ($AgI-Ag_3PO_4$)

Ideally one should like to study ionic solids in single crystals form. But due to ease of fabrication and acceptability in technological work, it is desirable to study powder compacts. High temperature sintering is also to be avoided as this process may results in stoichiometric and phase chang in fast ion solids.

Both these materials are silver ion conductors. The first one serves as a model material and the second may be considered a prototype of a material which may find practical applications. The second material was prepared in the laboratory.

It was decided to study the dependence of electrical properties of the selected materials on :

(i) Material preparation conditions,

(ii) Particle size,

(iii) Pelletizing pressure,

(iv) Temperature of measurement and

(v) Frequency of measurement.

Therefore, it was decided to study the materials as powder compacts. dc conductivity is known to yield valuable informations about the contribution of ions to total electrical conductivity. Low frequency measurements were planned to understand the electrode and electrolyte effects. The objective of these measurements was to collect informations about ion hopping rate, carrier mobility, mobile ion concentration etc. of solid electrolytes. These parameters have been used to support our findings in the microwave region.

A systematic study of dependence of electrical behavior of superionic conductors on various parameters was conducted at microwave frequencies. As the measurements at these frequencies are electrodeless, purely bulk information on fast ion conductors is obtained. The microwave technique adopted for measurements was developed earlier in our laboratory and satisfactorily used for a variety of materials.

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