CHAPTER - VII

SUMMERY AND CONCLUSION

The thin film materials are widely used in various industrial applications and Integrated Circuit (IC) technology to form solid state electronic devices. To know the basic properties of the material, characterization of material is essential. The resistivity and thermoelectric power are the most important electrical properties of the material. The measurement of these quantities provides information about the band structure, conductivity, carrier concentration etc. of the material. In electrical characterization the manual measurement of these parameters involves human & instrumental errors. To avoid the man made and instrumental errors, it is essential to develop an automatic measuring system for electrical resistivity and thermoelectric power measurement of thin film samples.

Now a days in the world of automation and control, the computer aided instrumentation and measurement becomes an important aspect in all fields. The powerful potential of computers is utilized in control and measurement systems to take data, analyze it and display the results on line or off line. In such systems the intelligence is moved from the system to software. In PC-based data acquisition system, transducers are used to convert physical parameters into electrical signals. After proper signal conditioning, these parameters are converted into digital form by using ADCs and read by the computer. The multiplexers, signal conditioning circuits, A/D converter, etc. form the data acquisition system. All these system components operate under the control of a computer.

In the present investigation, the dedicated PC-based data acquisition system is designed and developed for the measurement of electrical resistivity and thermoelectric power of thin film samples. The K-type thermocouple is used as temperature sensor. The resistivity and TEP measurement requires sensing of system parameters such as temperature, voltage, current, thermoemf and temperature gradient. All these input parameters are sensed and signal conditioned in the voltage range 0-5V. By using standard interfacing A/D card PCL-207 these signals are converted into digital form and read by the computer. The digital data values of the parameters are stored in different files. By using this data the required computations are performed. This computed data is further used to plot the graphs of resistivity versus temperature and thermoemf versus temperature difference. To carry out all these functions a user friendly menu driven application software is developed in higher level language 'C'. From the graphs plotted, user can deduce the information regarding to resistivity and TEP of thin film samples.

The present work is divided into six different chapters.

Chapter - I deals with the introduction and survey of literature regarding the electrical resistivity and TEP measurement techniques and various systems presently used for measurement purpose. The statement of the problem is explained at the end of this chapter.

Chapter - II describes the theoretical background of the electrical resistivity and TEP measurement techniques. The Four point probe and two point probe contact type methods are included in it. The basic signal conditioning concepts are explained at last.

The mechanical system design and development of Four probe resistivity and TEP measurement set up is described in Chapter - III. The basic system configuration and its operation are also explained in this chapter.

Chapter - IV deals with the design and development of electronic system needed for signal conditioning of resistivity and TEP measurement parameters. The circuit design details of the different circuits used for temperature, voltage, current, thermoemf and temperature gradient measurement are explained in detail.

The interface of the system and system software development is explained in detail in Chapter - V. The system software is menu driven which consists of measurement module, computational module and display module. The measurement module performs the task of data collection required for resistivity and TEP measurement. The computational module performs the task of computation on previously stored data to determine the resistivity of the sample. The display module performs the task of displaying the data in numerical or graphical form.

Chapter - VI deals with actual system performance in which the electrical resistivity and thermoelectric power measurements are carried out on few samples. These results are compared with the manually obtained results. It is found that the system performance is better than manual measurements with time saving and ease of operation.

The PC-based electrical resistivity and TEP measurement system is tested by using CdO and ZnO thin film samples. From the system performance test results following important conclusions are drawn :-

1. The developed computer based data acquisition system is very useful in measurement and displaying properties of the thin film material, like electrical resistivity and thermoelectric power.
2. The accuracy of the system is well within the acceptable range.
3. Looking into the percentage error for various parameters, this system is quite feasible and acceptable as the percentage error is well within the tolerable limits.
4. The accuracy of the present system can be improved by using standard monolithic instrumentation amplifiers for signal conditioning of thermoemf & temperature difference and by using shielding techniques and higher bit ADC.
5. The present system operates in the temperature range of 25 - 450°C. By recalibrating the system user can set another temperature range.
6. It includes both Four point probe and Two point probe resistivity measurement techniques. So that one can carried out measurements on low and high resistive thin film samples.
7. User friendly software of the system facilitates easy operation and automization.
8. A pellet holding arrangement in the system is useful for measuring the thermoelectric power of the materials in pellet form.