DESIGN AND FABRICATION OF FULLY AUTOMATED EXPERIMENTAL SETUPS FOR CHARACTERIZATION OF THERMOELECTRIC MATERIALS

A THESIS

submitted by

ASHUTOSH PATEL

(Enrollment no.: S14006)

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DECLARATION BY RESEARCH ADVISOR

This is to certify that the thesis entitled "**DESIGN AND FABRICATION OF FULLY AUTOMATED EXPERIMENTAL SETUPS FOR CHARACTERIZATION OF THERMOELECTRIC MATERIALS**", submitted by **Ashutosh Patel**, to the Indian Institute of Technology Mandi, for the award of the degree of **Master of Science**, is a bonafide record of the research work done by him under my supervision. The contents of this thesis, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.

Place: Mandi
Date: 3rd June 2017

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DECLARATION BY RESEARCH SCHOLAR

This is to certify that the thesis entitled "**DESIGN AND FABRICATION OF FULLY AUTOMATED EXPERIMENTAL SETUPS FOR CHARACTERIZATION OF THERMOELECTRIC MATERIALS**", submitted by me, to the Indian Institute of Technology Mandi, for the award of the degree of **Master of Science**, is a bonafide record of the research work done by me under the supervision of Dr. Sudhir K. Pandey. The contents of this thesis, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.

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ABSTRACT

In this thesis, We discuss the fabrication of the experimental setups for Seebeck coefficient (α) and thermal conductivity (κ) measurement at high temperature. We also discuss the fabrication of high temperature figure of merit ($Z\bar{T}$) measurement setup, which can measure α, κ, and electrical resistivity (ρ), simultaneously to find out $Z\bar{T}$ value. Simple design and use of minimal components make these setups compact, lightweight, and more user-friendly. A dedicated thin heater is built to heat the sample. It's small cross section (8mm×8mm) and very low thickness (∼1mm) minimizes the heat loss and further simplified the sample holder design. Heat loss value required for thermal conductivity measurement has been found out by developing a simple measurement methodology based on the parallel thermal conductance technique. Low heat loss is achieved by using gypsum insulator block and by optimizing its dimension. The requirement of more number of sensors and wires in the simultaneous measurement of α, κ, and ρ have been resolved by performing temperature as well as voltage measurements using same thermocouples. Use of commonly available low-cost materials and in-house fabrication of components including thin heater reduces the cost of the setup. It also provides low cost and easy replacement of any parts in case of damage. Low cost, lightweight, compact design, and use of minimal components are the key features of these measurement setups.

KEYWORDS: Figure of merit; Z meter; Seebeck coefficient; thermopower, Thermal conductivity; Heat loss; High temperature setup; LabVIEW; Thin heater.

TABLE OF CONTENTS