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Approved for Public Release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT
Funds from this instrumentation grant were used to purchase a magneto-optical cryostat capable of producing 5 Tesla magnetic fields and sample temperatures between 10 and 300 K. The new instrument will be used in conjunction with our current facilities for time-domain thermoreflectance measurements of thermal conductivity. This new experimental capability will provide novel information on how modifications of material microstructure, composition, and processing affect the thermal and electrical transport properties and thereby facilitate the continuing development of high efficiency materials for thermal-to-energy conversion and refrigeration.

15. SUBJECT TERMS
magneto-optical cryostat; thermal conductivity; thermoelectrics; energy conversion; electronic heat conduction

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Final Report September 27, 2010

Acquisition of a magneto-optical cryostat for measurements of thermal conductivity in high magnetic fields, ONR grant no. N00014-09-1-0771

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A. Project description

Funds from this grant were used to purchase a magneto-optical cryostat capable of producing 5 Tesla magnetic fields and sample temperatures between 10 and 300 K. This apparatus will enable us to extend the capabilities of our measurements of thermal conductivity by time-domain thermoreflectance (TDTR) to encompass measurements of electrical transport properties. Combined with independent measurements of the carrier density, the "geometrical magneto-thermal-resistance" can be used to determine the mobility of charge carriers in the weak-field limit. The anticipated short-term outcome is the development of a robust tool for high-throughput and spatially-resolved measurements of the mobility of charge carriers in thermoelectric thin film and thin layer materials in the through-thickness direction. This new experimental capability will provide more complete and accurate information on how modifications of microstructure, composition, and processing affect the thermal and electrical transport properties and thereby facilitate the continuing development of high efficiency materials for thermal-to-energy conversion and refrigeration.

We selected the MicrostatMO manufactured by Oxford Instruments because it provides an optimal trade-offs between performance, ease-of-use, and compatibility with our TDTR apparatus. The MicrostatMO is compact and designed for easy integration with optical tables. High resolution optical microscopy is enabled by the short working distance between the sample stage and the optical window. The superconducting solenoid magnet produces a maximum magnetic field of $B = 5$ T. The sample is mounted on a detachable insert that can be temperature controlled from 7 to 300 K.

B. Current status

Unfortunately, we do not have any research to report using this instrument because of problems caused by what we currently believe to be manufacturing defects. The symptoms of the problems were erratic cool down times and base temperatures insufficient to operate the superconducting magnet. The repaired instrument is expected to be returned in October 2010 and we hope to begin using the instrument during the spring 2011 in studies of high-mobility thermoelectric materials for refrigeration at room temperature and below.

C. Timeline

August 19, 2008	Proposal submitted
April 13, 2009	Grant from ONR executed by U. Illinois
April 30, 2009	Final quote obtained from Oxford Instruments
August 2009	Order acknowledgement recevied from Oxford Instruments
Sept. 2, 2009	Instrument received
July 16, 2010	Instrument returned for repair
October 2010	Expected date of return of instrument to U. Illinois