Method To Probe Bulk And Surface States In Thermoelectrics And Topological Materials

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SUMMARY
Researchers in the department of Chemistry and Biochemistry at UCLA have developed a non-invasive, site-specific method to probe the electronic structure of both surface and bulk states within thermoelectric and topological insulator materials.

BACKGROUND
The electronic structure of novel materials such as thermoelectrics and topological insulators can be difficult to characterize. The existing techniques often require high quality (crystalline) samples and very low temperatures (>20 K). This limits characterization of materials that are of lower quality or operate in a temperature gradient. The existing techniques often utilize volume-averaging measurements, making the distinction between bulk and surface states difficult to resolve. This limits characterization of materials whose topological features affect their electronic response. In addition, the results can also be highly dependent on experimental conditions such as electrode placement.

INNOVATION
Researchers from UCLA’s department of Chemistry and Biochemistry have developed a non-invasive, site-specific method of electronic structure characterization. This method allows for higher temperature (possibly up to room temperature) measurements of crystalline, non-crystalline, and granular samples. This alleviates the need for cryogenic conditions and high quality samples. Because thermoelectric and topologically insulating materials may possess desirable properties without being high quality (crystalline), these advancements enable characterization of a whole new subset of potential materials. Furthermore, this method is site-specific; a necessity when trying to separate the effects of electronic surface states from bulk states in topological insulators. This technology can be directly applied to both quality assurance and research and development in the fields of not only thermoelectrics and topologically insulating materials, but anywhere characterization of the electronic structure of surface states needs to be resolved from that of bulk states over a wider range of temperatures.

APPLICATIONS
- Thermoelectrics
- Heating/cooling devices
- Waste heat energy harvesting devices
- Topological Insulators
- Spintronics
- Quantum computing

ADVANTAGES
- Higher temperature characterization
- Non-crystalline and granular samples can be characterized
- Ability to resolve electronic surface states from bulk states

STATE OF DEVELOPMENT
This method has been refined and proven effective in the characterization of thermoelectric and topologically insulating materials.

RELATED MATERIALS

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS
- Reducing Computational Complexity of Training Algorithms for Artificial Neural Networks
- Image Filtering Algorithm for Enhanced Noise Removal and Feature Preservation
- Biologically Applicable Water-Soluble Heterogeneous Catalysts For Parahydrogen-Induced Polarization