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Ph.D. DISSERTATION DEFENSE

Candidate: Elham Easy
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Title: MANUFACTURING AND CHARACTERIZATION OF THERMAL TRANSPORT PROPERTIES IN TWO-DIMENSIONAL MATERIALS

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ABSTRACT

This dissertation highlights the significance of understanding and accurately calculating thermal transport properties in various fields. Focusing on thermal transport properties, the study utilizes the opto-thermal Raman technique to investigate the thermal conductivities and interfacial thermal conductance of WSe_2 and Fe:MoS_2. Additionally, a novel measurement technique is introduced for precise thermal conductivity mapping.

Using the opto-thermal Raman technique, the thermal conductivities and interfacial thermal conductance of 1-3L WSe_2 and Fe:MoS_2 are determined. The layer-dependent trend of lateral thermal conductivity and interfacial thermal conductance in these materials is observed, offering valuable insights into nanoscale heat dissipation and energy conversion. These findings hold significant potential for advancing electronic and optoelectronic device technologies.

The dissertation also presents an improved approach for measuring thermal conductivity, utilizing thermal mapping with two lasers for heating and probing. This technique enables accurate and reliable thermal conductivity determination, facilitating the design of microelectronic devices.

Furthermore, the study explores novel nano-manufacturing techniques for graphene-based structures. These techniques play a crucial role in transferring high-quality 2D materials onto flexible substrates and achieving precise suspensions over holes or trenches. The implications of these advancements extend to diverse fields, including electronics, energy, and biomedical engineering.

In conclusion, this dissertation contributes to the fundamental understanding of thermal transport properties in various materials. The importance of accurate measurement techniques, exemplified by the opto-thermal Raman technique, is emphasized. Additionally, the research introduces innovative developments in thermal mapping and nano-manufacturing techniques. Ultimately, these findings have practical applications, advancing thermal management strategies and enabling the fabrication of flexible devices across multiple disciplines.