Flexible High Thermal Conductivity Fabrics for Applications in Wearable Electronic Devices

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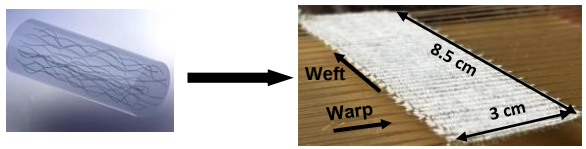
Objective

Characterize effective thermal conductivity and bending behavior of fabrics constructed from high thermal conductivity polymer fibers

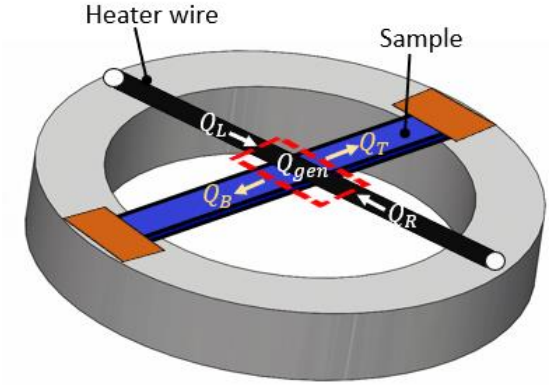
Nano/Micro-Fibers **Macroscale Fabrics**



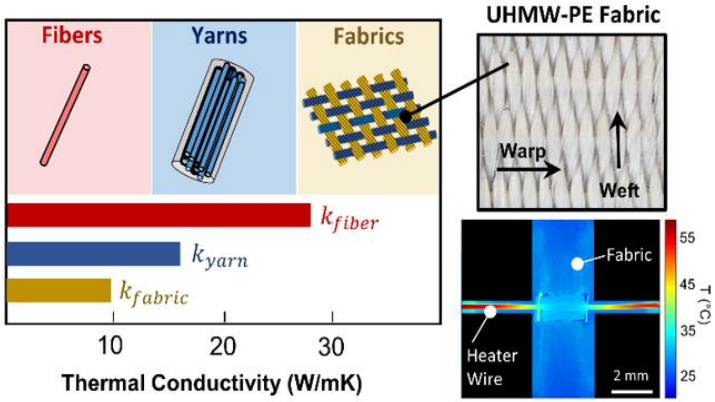
Shen *et al.*, *Nat. Nano.*, 2010.

Approach

- Review and identify high thermal conductivity polymer fibers
- Develop methodology for thermal characterization (based on IR thermography) and bend testing (based on standard ASTM techniques)
- Develop a reduced-order model to predict fabric thermal conductivity as a function of weave parameters



Schematic drawing of the setup used to characterize in-plane thermal properties of the high thermal conductivity fabrics based on Fourier's Law and energy balance



In-plane thermal conductivity of UHMW-PE (Dyneema) fibers, yarns, and fabrics measured using infrared thermography

Impact

- Developed a novel steady-state measurement technique for in-plane thermal characterization
- Achieved high fabric in-plane thermal conductivity compared to conventional fabric materials
- Assessed application of high conductivity polymers to aid in the thermomechanical design of flexible/wearable heat spreaders

Publications

A.A. Candadai, J.A. Weibel, and A.M. Marconnet, *ACS Applied Polymer Materials*, 2, 2020. DOI:10.1021/acsapm.9b00900

A.A. Candadai, J.A. Weibel, and A.M. Marconnet, *IEEE ITherm, May 2019*. DOI:10.1109/ITHERM.2019.8757385

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