

Faculty of Engineering

Summer Research Program 2024-2025

Project Title: "Innovative Thermoelectric Materials: Shaping Future Energy and Thermal Technologies"

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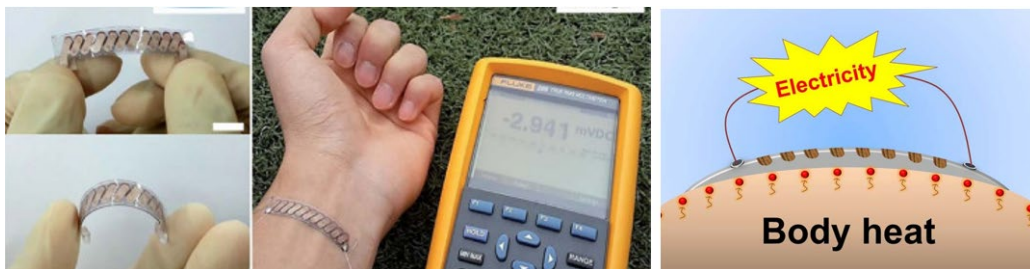
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Objective

Thermoelectric (TE) materials use temperature differences to generate electrical energy, offering electric heating and cooling without moving parts or refrigerants. They can also harvest waste heat and convert it into electricity. However, current devices are limited by low efficiency and the sustainability of materials. To expand into broader applications, new sustainable materials with higher performance are needed, along with improved engineering of nanoscale interfaces and devices, which is the objective of this project.

Project Details

TE materials show promise for sustainable energy applications, potentially providing 15 terawatts globally. Utilizing TE materials can lead to significant energy savings, economic benefits, and reduced reliance on fossil fuels, thus lowering greenhouse gas emissions. Flexible and conformal thermoelectric generators (TEGs) have various applications, including powering sensors, biomedical devices, and wearable electronics, as well as providing localized cooling and refrigeration. However, conventional TE devices are expensive and based on rigid bulk materials, calling for advanced manufacturing strategies to develop new materials with scalability, flexible manufacturing processability and reduced cost.



Recently, our research group developed some new materials capable of efficiently converting heat to electricity. These materials are based on metal-organic frameworks (MOFs), which are highly porous materials and exhibit low thermal conductivity, a key factor for a high-performance thermoelectric material. Thus, this project aims to develop new printable ink materials suitable for flexible, wearable thermoelectric devices.

Prerequisites

Having a background in materials science, chemistry, and chemical or electrical engineering.