

# Theme : Energy Harvesting

## Subject : Flexible Thermoelectric Generators (TEGs)

### Introduction

The goal of this research project is to explore novel thermoelectric materials and/or proto-type thermoelectric generators (TEGs), which have flexibility for the application of wearable energy harvesting devices or mobile electronic devices. The new-type thermoelectric materials and/or TEGs, which is converted into electrical energy from body heat or wearable device heat, should have high thermoelectric figure of merit ( $ZT$ ), low conduction of heat through TEGs, and low electrical contact resistance for serving as an always-available renewable power source.

In case of the novel materials, we expect the nanomaterials and/or nanocomposites to go beyond the existing commercialized products based on the bulk materials. In case of the TEGs, we expect the thermoelectric performance increase due to the advanced design of modules by considering thermal and electrical matching of TEGs and allowable heat sink for wearable devices.

### Scope

Challenges of increasing  $ZT$  and/or Seebeck coefficient and overall efficiency of flexible TEGs technology include:

- Methods to overcome the current thermoelectric performance
- Study of new materials and/or advanced nanocomposite structure with n and p-type, respectively.
- Methods to provide a novel materials and/or module design with flexibility for application of the wearable energy harvesting devices or mobile electronic devices
- Methods to decrease negative impacts on  $ZT$  such as conduction of heat through TEGs and electrical contact resistance.

### Research questions

We are interested in the following research questions. These questions are not exhaustive but different research questions are open to discuss with research partners.

- What would be strong candidate materials for flexible TEGs with high performance?
- What would be the most effective design of TEGs with flexibility preventing the thermal steady state between heat sink and human skin?
- How can maximize the electric output of TEGs?
- Is it possible to overcome the theoretical limitation of  $ZT$  using conventional thermoelectric materials?

### Expected Deliverables

The following is open to discussion:

- Suggestion of advanced materials with new structure and/or composition.
- Detailed progress reports every 3 months summarizing accomplishments.
- Prototype samples
- Journal publications and patents with SAIT (if agreed)