

**MECHANICAL AND MATERIALS ENGINEERING  
COLLEGE OF ENGINEERING AND APPLIED SCIENCE**

**SUMMER RESEARCH OPPORTUNITIES FOR UNDERGRADUATE WOMEN**

**APPLICATION DEADLINE: 01/17/2018**

**PROJECT TITLE: Wearable human body-heat energy harvesting devices**

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**Project Description**

In this project, students will participate in the development and characterization of flexible and wearable thermoelectric (TE) power generators for human body-heat energy harvesting. When the TE device is attached on the human skin, e.g. on the wrist as a watch-type device, heat flows from the skin through the device to the ambient air due to the temperature difference between the skin surface and the ambient. This heat is converted to electricity in the device based on the physical phenomenon called the Seebeck effect. Special type of TE device structure called the transverse geometry will be employed in this project for low-cost, high performance, and easy manufacturing with 3D printing. Flexible polymer-carbon nanotube composite materials will be synthesized using solution-processing techniques as the working TE medium. Tilted metallic layers will be 3D-printed at UCRI (Univ. Cincinnati Research Institute) Advanced Manufacturing Center to guide heat and electricity in the device. Thorough device and material characterization will be performed with the developed energy harvesters to evaluate the power generation performances with applied temperature gradient in the lab environment and also in wearable applications on the human skin.

Participating students will be able to learn the following scientific and technical knowledge throughout the project:

- (1) Physical principles of thermoelectric energy conversion
- (2) Fundamentals of thermoelectric energy harvesting devices and materials
- (3) Device fabrication with solution-processed polymers and 3D-printed metallic layers
- (4) Device testing techniques for thermoelectric power generation
- (5) Electrical and thermal characterization of metallic and semiconductor materials