SEMS: RESEARCH PROJECT DESCRIPTION

1. Project Background and Description

Title: ***Composite thermoelectric materials for flexible thermoelectric devices***

Description: *Thermoelectric generators (TEGs) convert waste heat into electricity. This invites the possibility of self-powered devices which generate the energy they require from any temperature gradient. Asides from grid-scale power generation, these devices can operate as local power sources for electronics and sensors, eliminating the need to hardwire or change batteries. For example, a TEG placed on someone's skin could even generate electricity from the temperature gradient between their own body and the surrounding air. This could power a wireless medical sensor that monitors patients at their home and uploads data to the local hospital. Such devices could revolutionise future healthcare provision. Yet TEGs are not in common use outside of niche military and space applications. The reason for this is the cost and toxicity of current inorganic thermoelectric materials, as well as their weight, rigidity and brittleness.*

Polymer-composite thermoelectric materials are in the early stages of development, and the excitement surrounding them lies in their low cost, solution processability (they can be printed) and their mechanical flexibility. Yet little is known about printed TEG device physics, or how the component materials interact with one another. In this project, a TEG will be fabricated from composite materials by a printing process. These will be cheap, scalable processes that are much-needed for printed TEGs to become reality. Furthermore, this proposal is written with the conviction that a fundamental understanding of printed TEG device physics will accelerate the development of improved thermoelectric materials.

2. Project Scope

Research project objectives:

1. *Develop a prototype printed organic thermoelectric devices.*
2. *Study the parasitic loss factors in the device and develop methods to reduce these.*
3. *Develop a self-powered sensor powered by this thermoelectric device.*

3. Desired Skills from the Student

- Experience in any of:
  - Electrical characterization.
  - Materials characterization.
  - Energy devices.
  - Printed electronics.
- The ability to work in a laboratory environment.

Qualifications in any of: Materials Science, Electrical Engineering, Physics.

4. Supervisory Team

Primary supervisor: Dr Oliver Fenwick (School of Engineering and Materials Science)

Secondary supervisor: Dr Emiliano Bilotti (school of Engineering and Materials Science)

Additional supervisor: Dr Mark Baxendale (School of Physics and Astronomy)