

Draper Materials Design & Development Research Interests

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Introduction

Draper has a strong history of advanced materials design and development for extremely high performance systems

Research Interests

1. MEMS Stirling Engine (Priority)

Space probes and other high reliability systems have a need for power in remote, harsh environments that require novel materials

development to meet growing power and thermal management requirements while still maintaining small form factors. Today there are no micro power systems that have efficiencies greater than ~2% which meet all mechanical, thermal, and system requirements for space probes and other small form factor power needs. We'd like to apply innovative materials development to design, model and build a MEMS Stirling convertor which has the potential to increase the efficiency of small form factor thermal based power generators from 2 to 10+%.

2. Materials design and development for Energy and Power Technologies

Other areas of interest include novel materials and architectures that have potential to enable new energy and power systems that achieve extreme performance, ultra-low SWAP, and / or ruggedized operation in harsh environments

Example areas might include:

- a) Microelectronic coolers
- b) High temperature thermoelectric materials
- c) Radiation based power systems
- d) Battery development
- e) Piezoenergy transfer systems

Draper may share specifics of particular interests once the collaborative research topic are has been agree to.

3. Next generation materials for communication systems

The efficient transfer of data through high temperature, high radiation, remote, and/or other harsh environments is critical to ensure sufficient guidance navigation and control and information gathering.

About Draper Laboratory (www.draper.com)

Draper is an independent, not-for-profit corporation, chartered to work on problems in the national interest. Draper is **seeking collaborative research partners from universities** to further the state of the art in key technologies of mutual interest. Research Whitepapers describing Draper's technology interests and Technical Points of Contact can be found on the Draper Scholars webpage ([Draper Scholar Program | Draper](#)). The Draper Scholars Program funds thesis-bearing MS and PhD students at partner universities as one of the effective ways to progress the technology. Other means of collaborative research (e.g. joint proposals, sabbaticals, etc.) are also encouraged. Please contact education@draper.com if you have further questions.

Example areas might include:

- a) High temperature, rad hard transducers
- b) High temperature, rad hard electronic materials
- c) Undersea communication systems
- d) Hypersonic window materials

Draper may share specifics of particular interests once the collaborative research topic are has been agree to.

4. Polymeric Materials Development

Developing more accurate polymer based models will allow for rapid design across various systems and environments (ex. high temperature), high fidelity failure prediction and prevention which would advance US manufacturing by decreasing development costs and increasing reliability across many business sectors including electronics, biotechnology, & aerospace applications. Current approaches use microscopic models that are difficult to integrate at the system level. We'd like to develop a lumped element, plug and play non-linear model of polymer materials for Comsol type environments so that if material parameters are known and if interface features are inputs then the polymer behavior over time, temperature and stress is predictable. The focus areas might include smaller electronics systems but over a wide range of temperatures and stress, general polymer-ceramic arrays, bonded interfaces, and potted component models.

We would be targeting PhD students for the development of novel approaches; and MS students for the application of existing approaches to specific problems of interest to Draper.