ScMvr-3

Soldier and Small System Energy

S&T Campaign: Sciences for Maneuver
Energy and Propulsion

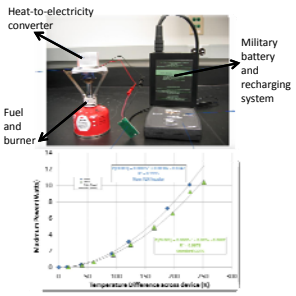
C. Mike Waits, Ph.D., (301) 394-0057, christopher.m.waits.civ@mail.mil
Patrick Taylor, Ph.D., (301) 394-1475, patrick.j.taylor36.civ@mail.mil
Ivan Lee, Ph.D., (301) 394-0292, ivan.c.lee2.civ@mail.mil

Research Objective

Investigate energy harvesting and conversion to enable extended duration, expeditionary-type missions with minimal physical burden and without the need for resupply

Wearable Energy Harvesters

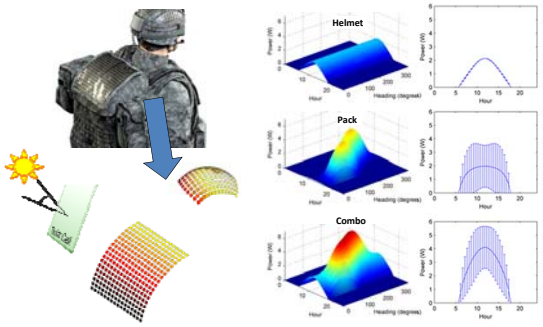
Man-portable Battery Recharging From Scavenged Waste Heat



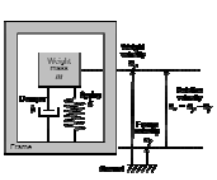
- Very High Power Density Values:
  = 10 Watts/0.0016m² ~ >5000 Watts/m²

Challenges

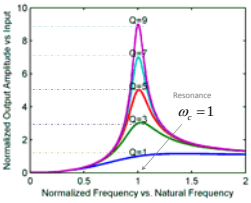
- Energy harvester models must account for realistic usage profiles and cover multiple scales from system level to device physics level for adaptability
- Materials with high transduction efficiency for thermal to electrical energy conversion
- Component- and system-level models capable of informing materials development for optimization of specific energy, power density, and/or thermal performance



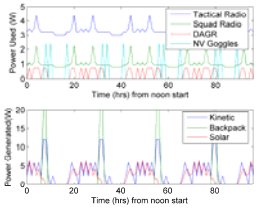
Conformal photovoltaic panels in motion



Electromechanical energy harvesting



Quality factor: Frequency selectivity vs. power output



Predicted energy usage and generation for mock scenario

ARL Facilities and Capabilities Available to Support Collaborative Research

- State-of-the-art III-V MBE system for PV, PEC materials and IV-VI MBE system for TE materials
- Ultrahigh vacuum variable temperature STM for tunneling spectroscopy and atomic imaging
- Device processing and characterization
- Unique thermoelectric materials zT characterization and device efficiency/power-density evaluation
- Time domain thermoreflectance pump-probe thermal characterization system
- LabVIEW controlled catalytic reactors, micro-GC and mass spectrometer, FTIR spectrometer with in-situ time-resolved capability, physisorption-chemisorption analyzer

Complementary Expertise/Facilities/ Capabilities Sought in Collaboration

- Energy-harvesting devices for characterization and modeling in Army-relevant scenarios
- Devices and topologies that exploit multimodal energy transduction for more power dense and predictable generation
- Thermal-to-electric materials and devices development partners
- Fuel combustion catalysts development
- Multifuel or JP-8 fueled mesoscale and micro-combustion modeling and device development
- Energy conversion and harvesting component integration and systems modeling