Alternative Energy

S&T Campaign: Materials Research
Energy & Power
Power Generation & Energy Harvesting

Kimberly A. Sablon
(301)-394-5791
Kimberly.a.sablon.civ@mail.mil

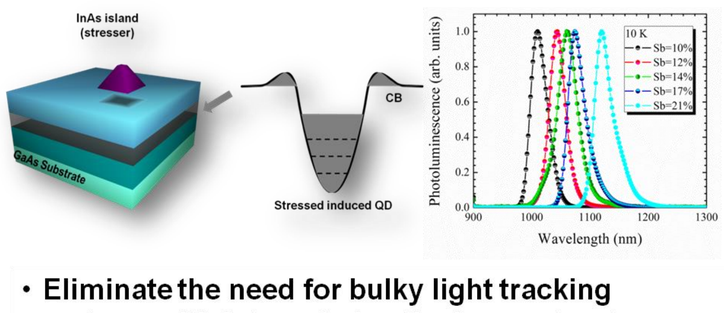
Research Objective

- **Develop compact, portable power sources that can sustain long mission times (>72hrs) while reducing the physical burden to the Warfighter.**
- **Reduce logistic resupply of fuel by producing fuel on the battlefield with readily available resources.**
- **Improve overall operational energy efficiency (OEF) by converting waste and freely available resources to energy.**

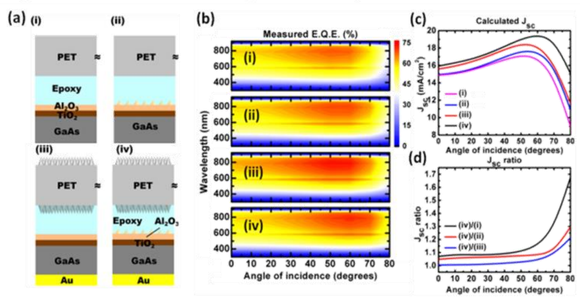
ARL Facilities and Capabilities Available to Support Collaborative Research

- **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**
- **Full electrochemical characterization including in-situ AFM**

• Extend the spectral range using nano-enhanced absorber materials:

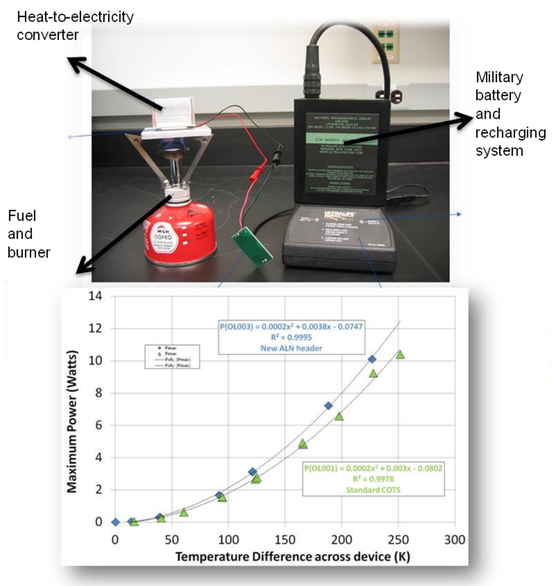


• Eliminate the need for bulky light tracking systems with integrated optical nanostructures:



PHOTOVOLTAICS

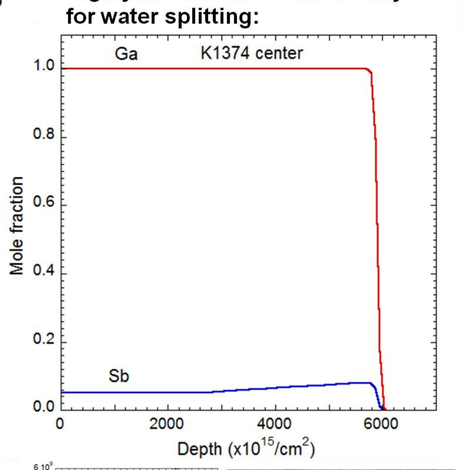
•Develop Higher Operating Temperature Active Converter Materials: Pout ~ ΔT2



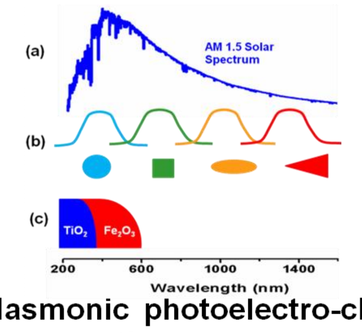
• Very High Power Density Values:
= 10 Watts/0.0016m2 ~ >5000 Watts/m2

THERMOELECTRICS

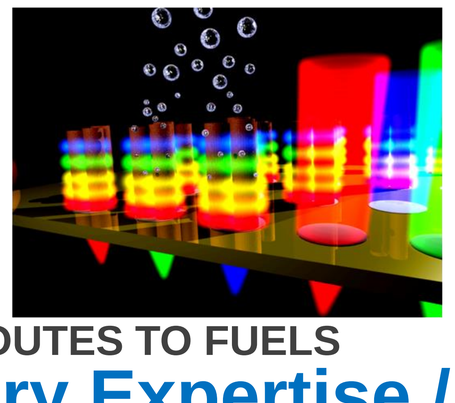
• Highly mismatched GaNSb alloys for water splitting:



• Tuning plasmon for harvesting solar light



• Plasmonic photoelectro-chemical cell for H_2 generation



ALTERNATE ROUTES TO FUELS

Challenges

- **Enhancing performance at normal incidence while improving the transmission at wider angles of incidence (PV).**
- **Increasing spectral bandwidth while maintaining high absorption strength (PV).**
- **Developing materials having larger thermoelectric zT at higher T (TE).**
- **Integrating topological insulator phenomena to enhance zT across broad temperature range (TE).**
- **Identify effective photocatalyts for harvesting solar energy for conversion to chemical fuels.**
- **Transfer plasmonic energy from a metal to a semiconductor.**
- **Developing tunable wide bandgap semiconductors to split water that have suitable bandgap and band edge energies that are stable to photocorrosion**

Complementary Expertise / Facilities / Capabilities Sought in Collaboration

- **Time-resolved photoluminescence up to 2 micron**
- **Angle-Resolved Photoelectron Spectroscopy**
- **High resolution SIMS**
- **Sophisticated optical modeling of nanostructure-based devices**