NASA SBIR/STTR Technologies

Proposal No. T8.01-9920 - *Ultraefficient Thermoelectric Devices*

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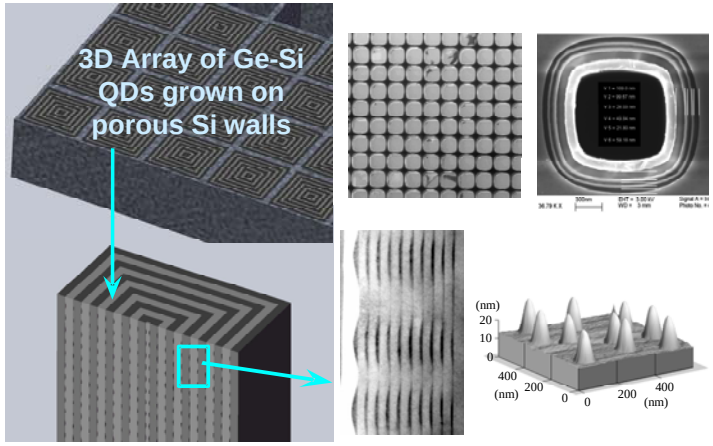
Identification and Significance of Innovation

New high conversion efficiency TE devices, as well the manufacturing methods need to be developed to meet the growing NASA, DoD and commerical needs in thermoelectric energy. The team of MicroXact Inc and UCLA DRL is proposing to develop a revolutionary ultrahigh efficiency thermoelectric material fabricated on completely new fabrication principles. The material comprises the three-dimensional "wells" of Ge-Si Quantum Quantum Dot Superlattices fabricated by a conformal coating of macroporous silicon (MPSi) pore walls. Such a material will provide very high ZT values at macroscopic thicknesses of the material, permitting 30% or more conversion efficiencies.

Expected TRL Range at the end of Contract (1-9): 5



Technical Objectives and Work Plan

Technical Objectives:

•O1 – Develop the model of 3D QDS array on macroporous silicon walls.

•O2 - Prove the feasibility of the proposed concept by modeling/simulations.

•O3 - Prove the feasibility of key processes.

•O4 - Develop strategies for product commercialization and transition to manufacturing.

Work Plan:

•Task 1 – Develop the theoretical model of the proposed material .

•Task 2 - Design the thermoelectric device to meet 30% efficiency goal and validate the performance through simulations/modeling .

•Task 3 - Develop the process of macroporous silicon fabrication.

•Task 4 - Develop the process of QDS growth on macroporous silicon pore walls and demonstrate conformal coating of pore walls with a single-layer QDS.

•Task 6 - : Develop the concept of Phase II, commercialization strategy, and transition to manufacturing.

NASA and Non-NASA Applications

• Thermoelectric Generators for space missions (NASA).

• Thermoelectric modules for electronic components (NASA, DoD, commercial).

• Submarine TE coolers (DoD).

• TE coolers for Army suits (DoD).

• Remote power applications (DoD, DoE, commercial).

• Automotive industry- climate control and waste heat utilization (commercial).

• Cooling in medical and scientific applications

• Industrial cooling and waste heat recapture

Firm Contacts

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NON-PROPRIETARY DATA