# Conference Proceeding

**Title:** High Energy Effects on Thermoelectric and Optical Properties of Si/Si+Sb Nanolayered Thin Films

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**Abstract:**
We have prepared thermoelectric devices from alternating layers of Si/Si+Sb superlattice films using ion beam assisted deposition (IBAD). In order to determine the stoichiometry of the elements and the thickness of the grown multi-layer film, Rutherford Backscattering Spectrometry (RBS) and RUMP simulation have been used. SEM and EDS have been used to analyze the surface and composition of the thin films. The 5 MeV Si ion bombardments have been performed using the AAMU Pelletron ion beam accelerator, to make quantum clusters in the multi-layer.

**Subject Terms:**
Ion bombardment, thermoelectric properties, multi-nanolayers, figure of merit.
ABSTRACT
We have prepared thermoelectric devices from alternating layers of Si/Si+Sb superlattice films using ion beam assisted deposition (IBAD). In order to determine the stoichiometry of the elements and the thickness of the grown multi-layer film, Rutherford Backscattering Spectrometry (RBS) and RUMP simulation have been used. SEM and EDS have been used to analyze the surface and composition of the thin films. The 5 MeV Si ion bombardments have been performed using the AAMU Pelletron ion beam accelerator, to make quantum clusters in the multi-layer superlattice thin films to decrease the cross plane thermal conductivity, increase the cross plane Seebeck coefficient and increase the cross plane electrical conductivity to increase the figure of merit. Some optical instrumentations have been used addition to RBS and SEM.
High Energy Effects on Thermoelectric and Optical Properties of Si/Si+Sb Nanolayered Thin Films

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MRS-SP-2013
POSTER# H7.17

OBJECTIVES:
To tailor the thermoelectric and optical properties of Si/Si+Sb Nanolayered Thin Films

Important Parameters

\[ S = \text{Seebeck coefficient}, \]
\[ \sigma = \text{Electrical conductivity}, \]
\[ T = \text{Temperature}, \]
\[ \kappa = \text{Thermal conductivity}. \]

\[ ZT = S^2T/\kappa \] Figure of Merit
(Efficiency approaches Carnot Limit for high Figure of Merit)

Initial Measurements:

- Four Probe method for electrical conductivity
- Optical Absorption
- Photoluminescence
- AFM, RBS, Raman, Seebeck

S = -46 \mu V/K for unannealed 50 ML thin film

Photoluminescence Spectra From 20 ML of Si/Si+Sb multilayer films
Thickness= 177 nm

Optical Absorption Spectra From 20 ML Si/Si+Sb multilayer films
Thickness= 177 nm

Sponsors
Center for Irradiation of Materials (CIM), National Science Foundation under NSF-EPSCOR R-II-3 Grant No. DGE-1158862, DOD under Nanotechnology infrastructure Development for Education and Research through the Army Research Office # W911NF-08-1-0425, and DOD Army Research Office # W911NF-12-1-0063 and National Nuclear Security Admin (DOE/INNS/AIM8-10)

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