Seminar Talk

Xin Chen
PhD candidate
Department of Electrical and Computer Engineering
Old Dominion University

Tuesday, March 21, 2017
3:00 p.m. KH 224

Title: Enhancement of Thermoelectric Properties of ALD Synthesized PbTe/PbSe Nanolaminates Films by Phonon Engineering

Abstract:
Thermoelectrics (TE) is a green renewable energy technology which plays an import role in power generation due to its potential in generating electricity out of waste heat. The challenge for the development of thermoelectric is its low conversion efficiency. The efficiency of thermoelectric materials is related to the figure of merit, which is expressed as ZT = S2σT/, where S is the Seebeck coefficient, σ is the electrical conductivity, and is the thermal conductivity. In the quest to enhance ZT values, a key strategy involves the reduction in thermal conductivity, resulting from phonon scattering by numerous interfaces in low dimensional structures.

In this study, we reported an approach to enhance thermoelectric properties of traditional lead chalcogenide films by Atomic Layer Deposition (ALD) synthesizing PbSe and PbTe/PbSe nanolaminates films on patterned porous silicon templates implemented the phonon engineering concept. This talk presents the film deposition process, the physical and thermoelectric characterization of the nanolaminates films. The effect of the patterned substrates on the Seebeck coefficient and thermal conductivity of the films was investigated and analyzed. The PbTe/PbSe nanolaminates grown on porous silicon membranes have three times higher Seebeck coefficients than the ones grown on regular planar silicon wafers. The higher Seebeck values result from the lower thermal conductivity in porous structures, which in turn lead to a higher figure of merit ZT. We demonstrated the feasibility to enhance the figure of merit ZT further by modulating the size and periodicity of the pattern and the thickness of the thermoelectric film in relation to the mean free path (MFP) of the phonons of the thermoelectric material.

Bio:

Xin Chen is a Ph.D. candidate working with Dr. Helmut Baumgart in the Department of Electrical and Computer Engineering at ODU. She received her Bachelor degree in Physics from Anhui Normal University in China and her Master degree in Optics from the University of Shanghai for Science and Technology in China. Her research is focused on TE materials deposition by atomic layer deposition (ALD), TE materials characterization using microscopy technology, XRD, AFM, and thermoelectric characterization.