



CeNSE Industry Affiliate Lecture Series ASM Technologies

Title of the talk: High-performance, heteroepitaxial, nanolaminate device layers on single-crystal-like, artificial substrates and controlled self-assembly of nanostructures within device layers for wide-ranging electrical and electronic applications.

Synopsis: For many energy and electronic applications, single-crystal-like materials offer the best performance. However, in almost all cases, fabrication of single-crystal form of the relevant material is too expensive. In addition, for many applications, very long or wide materials are required, a regime not accessible by conventional single-crystal growth. This necessitates the use of artificially fabricated, large-area, single-crystal-like substrates suitable for heteroepitaxial growth of the relevant advanced material for the electronic or energy application in question. In this talk, details of the fabrication of such substrates will be provided. Heteroepitaxial growth of nanolaminate multilayers and devices on such substrates using a variety of deposition techniques such as pulsed laser ablation, sputtering, e-beam evaporation, MBE, MOCVD, and chemical solution deposition will be reported upon. Application areas that have been demonstrated via the use of such artificial substrates include – oxide high-temperature superconductors, semiconductor materials (Si, Ge, GaAs, Cadet, Cu_2O), ferroelectrics (BaTiO_3), multiferroics (BiFeO_3), etc. In addition, strain-driven self-assembly of second phase nanomaterials at nanoscale spacings has been demonstrated within device layers. Control of heteroepitaxy in lattice-mismatched systems and the effects of strain on self-assembly will be discussed. Such heteroepitaxial device layers on large-area, single-crystal-like artificial substrates are quite promising for a range of electrical and electronic applications.



Prof. Amit Goyal, Ph.D., MBA
 Member, National Academy of Engineering (NAE)
 Member, National Academy of Inventors (NAI) *Director*, The RENEW Institute @ SUNY-Buffalo *SUNY Empire Innovation Professor*
Emeritus Corporate Fellow, Oak Ridge National Laboratory
Fellow - AAAS, MRS, APS, ASM, ACERS, IOP, WTN, WIF

Date: 21st December 2018

Venue: CeNSE, IISc

Time: 11-12 noon

Tea & snacks: Before the talk

About the speaker: Prof. Amit Goyal is *Director* of The RENEW Institute, the University at Buffalo's interdisciplinary institute dedicated to research and education on globally pressing problems in energy, environment and water. He also concurrently holds the title of *SUNY Empire Innovation Professor at UB* in the several departments at the University. He is also the *President & CEO of TapeSolar Inc.*, a private-equity funded company and also the *President & CEO of TexMat LLC*, an IP holding and consulting company. He is presently also an *Emeritus Corporate Fellow at UT-Battelle/Oak Ridge National Laboratory (ORNL)*.

Dr. Goyal has developed clean energy technologies for over two decades. He has authored more than 350 technical publications and has 87 issued patents comprising 70 US and 17 International patents, and over 20 patents pending. Thompson-Reuters's Essential Science Indicators (ESI) and ScienceWatch.com, which tracks global trends and performance in research, ranked him as *most cited author worldwide* in the field of high-temperature superconductivity from 1999-2009.

He has received numerous accolades including the presidential level *DOE's E. O. Lawrence Award* in the inaugural category of *Energy Science & Innovation*. The US Department of Energy (DOE) Secretary on behalf of the President of the United States bestows the award.

He is a Member of the *National Academy of Engineering (NAE)* and the *National Academy of Inventors (NAI)*. He has been elected Fellow of eight professional societies: the American Association for Advancement of Science, the Materials Research Society, the American Physical Society, the World Innovation Foundation, the American Society of Metals, the Institute of Physics, the American Ceramic Society and the World Technology Network.

Dr. Goyal received a *B.Tech.(Honors) in Metallurgical Engineering* from the Indian Institute of Technology, Kharagpur (India), a *MS in Mechanical and Aerospace Engineering* from the University of Rochester, NY and a *PhD in Materials Science & Engineering* from the University of Rochester, NY, executive business training from the Sloan School of Management, MIT and an executive MBA from Purdue University and an international executive MBA Tilburg University (The Netherlands).