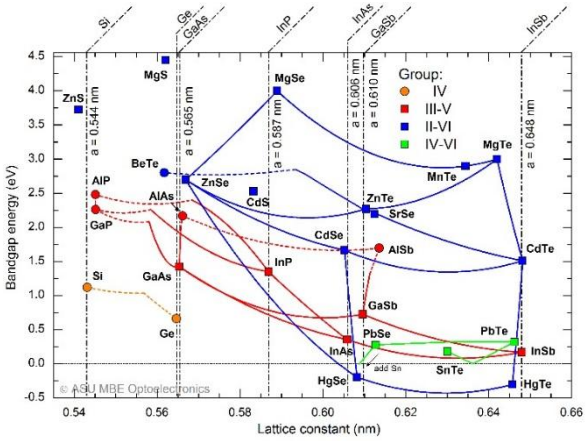
Seminars

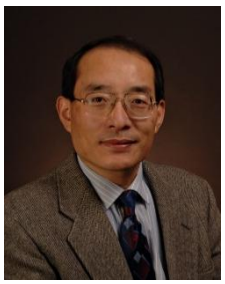
II-VI and III-V semiconductor integration and their applications

Yong-Hang Zhang
Directors of ASU NanoFab and Center for Photonics Innovation
School of Electrical, Computer and Energy Engineering
Arizona State University, Tempe, AZ 85287
Email: yhzhang@asu.edu Web Pages: http://asumbe.eas.asu.edu/

Abstract: Semiconductor electronic and optoelectronic materials and devices have experienced very rapid development for more than half a century. However, there still remains a lack of closely lattice-matched materials and substrates suitable for the monolithic integration of various kinds of semiconductor devices on a single chip. A new material platform: II-VI (MgZnCdHg)(SeTe) and III-V (AlGaIn)(PAsSb) semiconductor materials lattice-matched to GaSb, InAs and InSb substrates, has been proposed to achieve the goal. These materials have direct bandgaps covering a very broad energy spectrum from far IR (~0 eV) to UV (~3.4 eV) and small thermal mismatch. Such a unique material platform offers opportunities to study new physics such topological insulation in heterovalent superlattice and enables new light emitting devices, multi-junction solar cells, multi-color photodetectors, resonant tunneling diodes, and facilitates monolithic integration of various materials without misfit dislocations to ensure the best quality for device applications. This talk will focus on the following topics:



- Latest progress in the MBE growth of these heterovalent structures and their potential applications in ultrahigh efficiency multijunction solar cells, midwave IR VCSELs etc.
- $Mg_xCd_{1-x}Te/Mg_yCd_{1-y}Te$ (x=0 and 0.13, y>0.24) heterostructures on InSb substrates with record low interface recombination velocity (~1 cm/s) and ultra-long lifetime (3.6 μs), and crystalline CdTe solar cells with record high efficiency greater than 20%, and 1.7 eV $Mg_{0.13}Cd_{0.77}Te$ solar cell with efficiency of 11% for Si based tandem cell application
- Monolithically integrated CdTe/InSb dual color photodetectors
- A platform to study interfacial topological insulator states in various heterovalent superlattice like CdTe/InSb, ZnTe/GaSb, and ZnSe/GaAs



Brief Bio: Professor Zhang received his BS in Physics from Nanjing Normal University in 1982 and MS from the Institute of Semiconductor, Chinese Academy of Sciences, in 1987, and did his research at the Max Planck Institute for Solid States andreceived this doctoral degree in physics from the University of Stuttgart in 1991. He then worked as an Assistant Research Engineer at UCSB before he joined Hughes Research Labs in 1993. In 1996, he was appointed Associate Professor in the Department of Electrical Engineering at ASU and waspromoted to full professor in 2000. He edited 3 books, published 3 book chapters and more than 290 peered reviewed papers, presented 388 invited and contributed talks, 14 issued and pending US patents, and advised over 30 PhD students and supervised over 40 postdocs and visiting scholars. He is a fellow of IEEE and OSA, and served as the Associate Dean for Research at the Fulton Schools of Engineering, and is the founding director of the Center for Photonics Innovation, and the director of a university user facility ASUNanoFab. His areas of research interest include MBE growth, optical properties of semiconductor heterostructures, optoelectronic devices, and their applications. More information about his group can be found on the webpage:http://asumbe.eas.asu.edu/.