Our group studies the structural, compositional and morphological aspects of heteroepitaxial growth and formation of self-assembled nanostructures using surface reconstructions, modifications and dislocation patterns as templates, using surface sensitive probes in ultra-high vacuum. We have studied several metal/semiconductor and metal/metal interfaces and of late embarked on the synthesis and characterization of semiconductor heterostructures and band-gap engineering of materials (III-nitride) of interest in Solid State Lighting, Full Spectrum Photovoltaics, Water Purifications, High Electron Mobility Transistors, etc.

Epitaxial growth of Gp III-nitrides:

Using the sophisticated Molecular Beam Epitaxy technique, we have grown epitaxial GaN on c-plane(0001) sapphire substrates. Controlling growth parameters has enabled us to form GaN films with a patterned nano-wall network. At appropriate Nitrogen plasma density we form a high density of spontaneous hexagonal nano-wires of GaN with high aspect ratio. We have developed methods to selectively form high quality GaN films with zinc blende or wurtzite structures on the hexagonal silicon (111) 7x7 reconstructed surface. We have also demonstrated the fabrication of several device structures such as High Electron Mobility Transistor, Single InGaN quantum well, etc. To obtain lattice matched substrates for low defect epitaxial GaN growth, we have modified silicon surfaces by low temperature ion beam bombardment to form SiC/Si(111), GaN/GaAs and SixNy/Si(111) surface templates. The overlayer formation sequence and the properties of the heteroepitaxial multilayered