Spring 2024 Joint Colloquium
Materials Department & Materials Research Laboratory

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Oxide electronic materials – from ultra-wide bandgap semiconductors to metals with conductivities rivalling copper

Currently, 70% of all electrical power consumed is routed through power electronics and this fraction is set to increase even faster with further addition of renewable sources to the grid and electrification of transportation. A significant reduction in size, weight, and power loss (SWaP) of power electronics will revolutionize the way the electric grid operates. The lion's share of power electronics is based on silicon, with a bandgap of 1.1 eV. Significant reduction in SWaP is possible by migrating to semiconductors with wider bandgaps than silicon. Over the past 10 years, β-Ga_2O_3 with an ultra-wide bandgap of 4.8 eV has emerged as a promising material for next generation power electronics. In the first half of this seminar, I will outline my group's work on metal-organic chemical vapor deposition (MOCVD) synthesis, processing, and characterization of β-Ga_2O_3 epitaxial thin films and heterostructures for next generation power devices.

The energy consumption of computing is doubling every three years while the world's energy production is growing by approximately 2% a year, leading to a scenario where up to 10% of total energy production will be used for computation by 2040. New materials and computing paradigms are needed to head off this scenario. In the second half of my talk, I will outline my group's work on novel, lower dimensional oxide metals for electrical interconnects in integrated circuits to address this challenge.

Bio

Hari Nair received his BS from Indian Institute of Technology Madras. He received his PhD in Electrical and Computer Engineering from The University of Texas at Austin. His doctoral work involved molecular beam epitaxy (MBE) synthesis of GaSb-based semiconductor alloys for mid-infrared diode lasers. Following that he moved to Cornell as a postdoctoral researcher to work on MBE synthesis of complex oxides with Prof. Darrell Schlom. Hari Nair is currently an assistant research professor in Cornell MSE working on synthesis, processing and characterization of next generation of electronic materials.

Hosted by Sriram Krishnamoorthy