Toward High Power Complementary Logic in III-Nitrides: Is AlN the Answer?

Abstract:

Wide-bandgap III-nitride semiconductors, GaN in particular, are pushing to replace conventional semiconductors such as Silicon (Si) in a wide range of high power and high frequency applications, such as radar, cellular base stations. Taking advantage of the high intrinsic polarization properties of III-nitrides gives us high mobility 2D electron gases (2DEGs) at heterojunctions, which are used to make high quality n-channel transistors in the form of HEMTs. But the lack of a comparable performing p-channel transistor has held back Si CMOS-like efficient digital logic in III-nitrides electronics so far.

This talk will present AlN as a substrate platform as an alternative to current III-nitride technologies, and will illustrate how its wider bandgap, higher polarization and higher thermal conductivity gives it an advantage over the conventionally used GaN-substrate based III-nitride devices. In addition to high quality n-channel Quantum Well HEMTs, the long elusive high conductivity undoped 2D Hole Gas (2DHG) in nitrides has recently been discovered on this platform enabling record performance p-channel transistors. Combining both, AlN-substrate based devices provide the most promising platform for demonstrating and achieving efficient electronics via high-voltage complementary low-loss digital switches.

Biography:

Reet is a third year PhD student in Electrical Engineering under Professor Debdeep Jena and Professor Huili (Grace) Xing. He finished his undergrad in India from the National Institute of Technology, followed by a Masters in Applied Physics from Cornell before joining the group in the summer of 2016. His research interests include growth of Group III-Nitride heterostructures using Molecular Beam Epitaxy (MBE), and exploring the physics behind the electronic properties of these novel heterostructures for high-power, high frequency device applications.