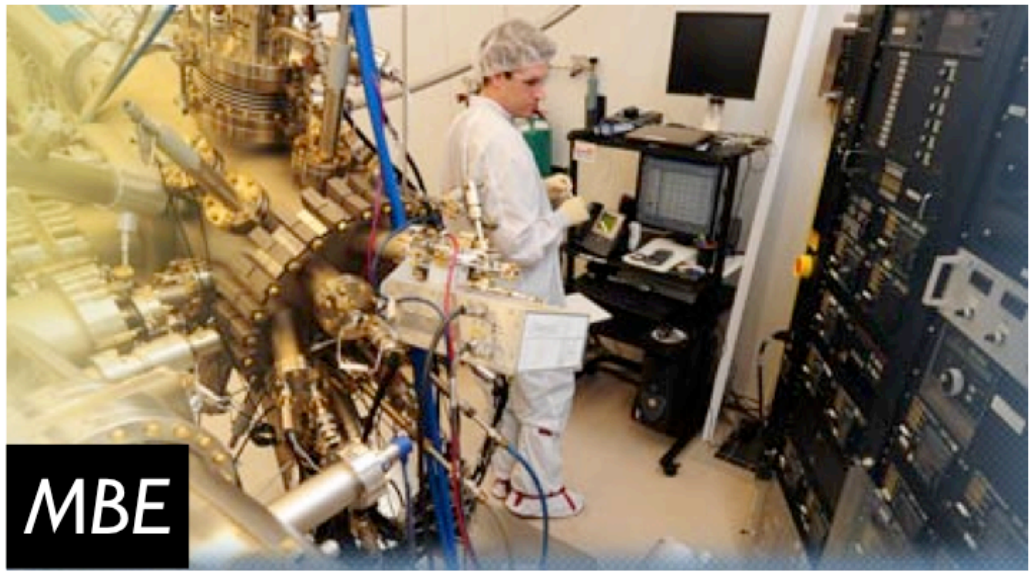
Jena research group



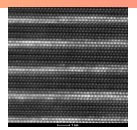
Nitrides | Oxides | Layered

Electronic devices | Photonic devices

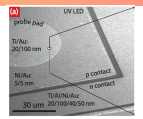
Physics-led theory and design of high-performance nanoelectronic and nanophotonic devices

$$\mathbf{J} = -\frac{ie\hbar}{2m}[\Psi^{\star}\hat{\mathbf{p}}\Psi - \Psi\hat{\mathbf{p}}\Psi^{\star}]$$

MBE growth and characterization of the designed quantum structures with atomic level control



Nanofabrication of nanoelectronic and nanophotonic devices with state of the art tools

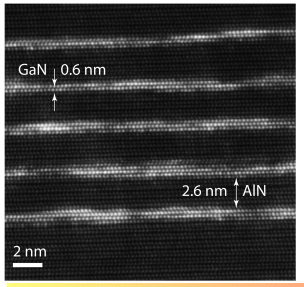


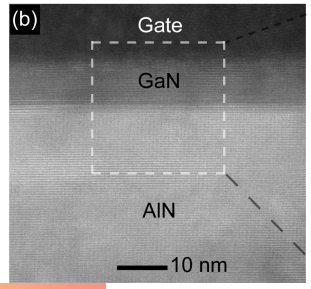
Measurement, characterization, and analysis of device performance, relate it to the device physics

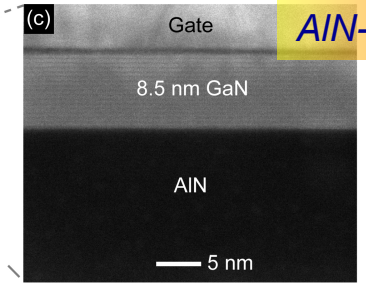
- *We do Molecular Beam Epitaxy of quantum heterostructures*
- *We are currently working on semiconducting Nitrides, Oxides, and 2D Crystals*
- *We do a significant amount of modeling and design for materials to devices*
- *We do nanofabrication of new electronic and photonic devices with these materials*

Debdeep Jena (djena@cornell.edu)

Range of bandgaps, geometries, and platforms

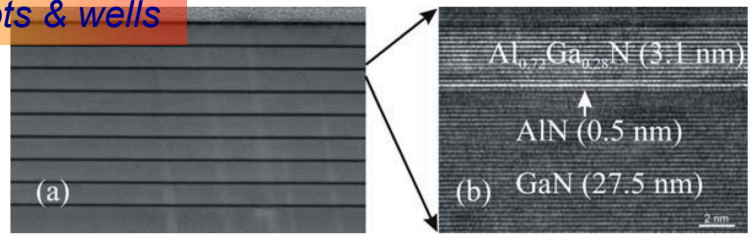


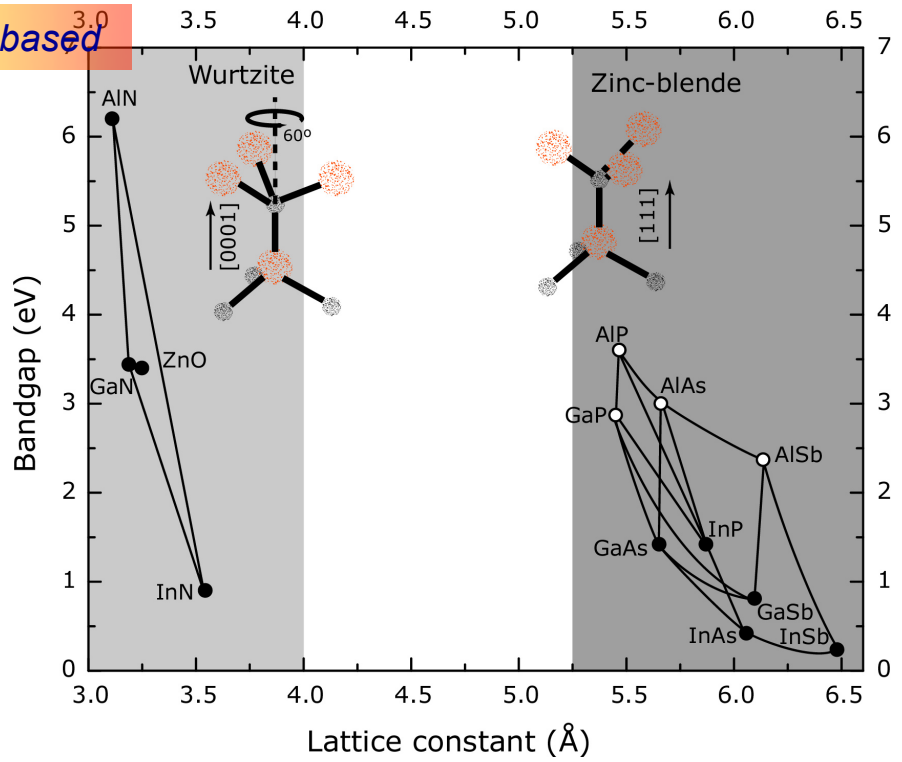




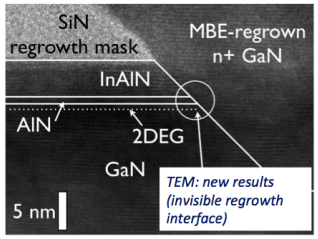
AlN-based

quantum dots & wells

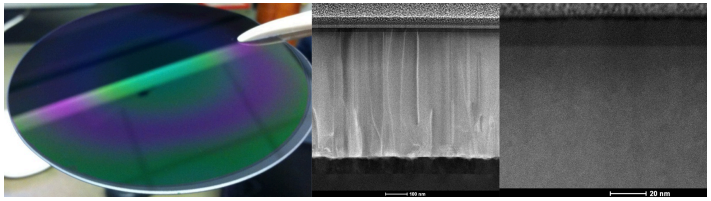


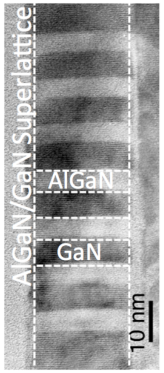


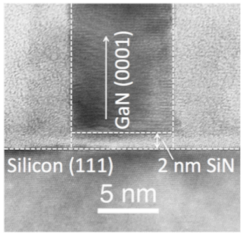
GaN-based HEMTs on SiC & sapphire

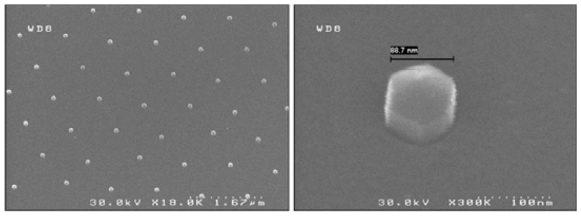


GaN on Silicon

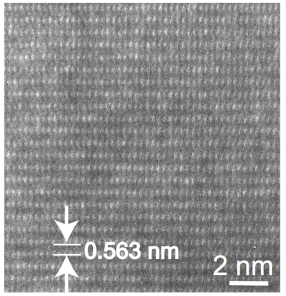








Nanostructures & patterned heterostructures



InN

- *III-Nitride nanostructures grown by MBE*

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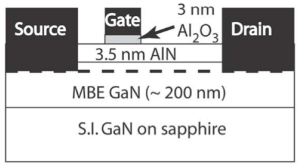
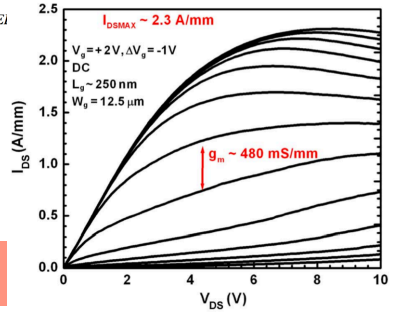
Resulting Device Technologies

IEEE ELECTRON DEVICE LETTERS, VOL. 29, NO. 7, JULY 2008 661

AlN/GaN Insulated-Gate HEMTs With 2.3 A/mm Output Current and 480 mS/mm Transconductance

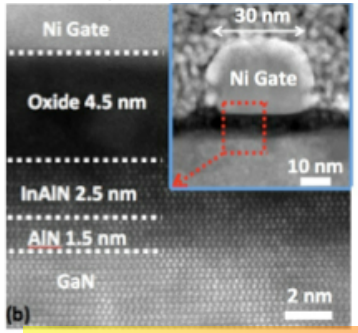
Tom Zimmermann, David Deen, Yu Cao, John Simon, Patrick Fay, *Senior Member, IEEE*, Debdeep Jena, *Member, IEEE*, and Huili Grace Xing, *Member, IEEE*



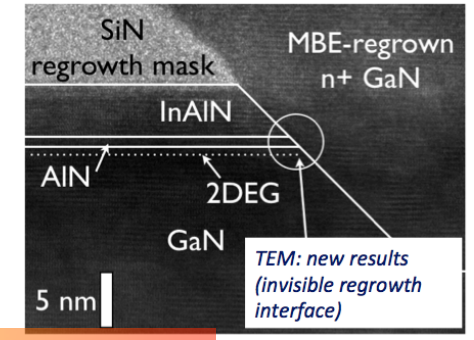


Ultrascaled GaN HEMTs

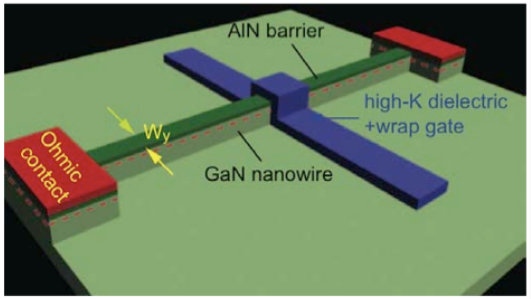
370 GHz f_T InAlN/AlN/GaN HEMT

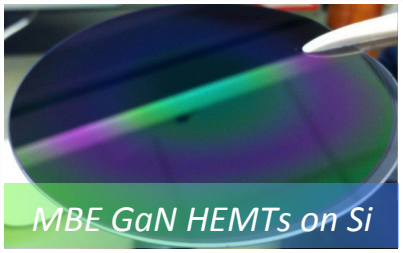


248/268 f_T/f_{max} GaN D-mode HEMTs

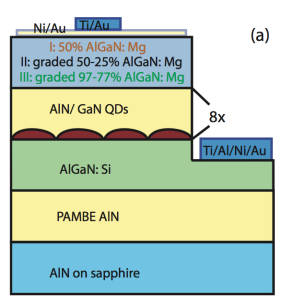


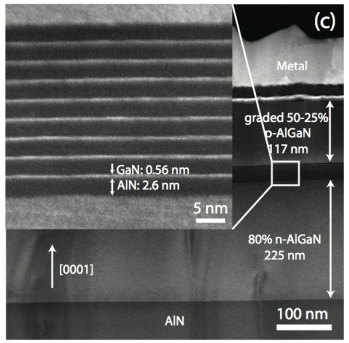
High-speed GaN HEMTs

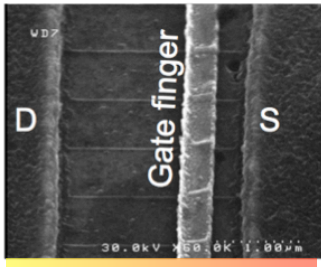


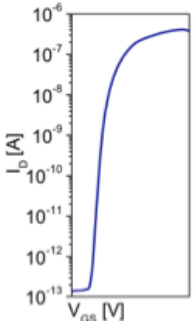


MBE GaN HEMTs on Si









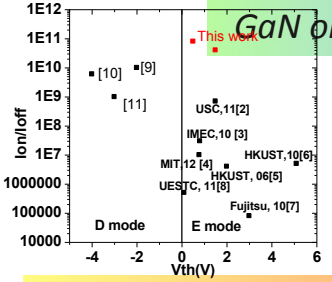
Tri-gate HEMTs

IEEE ELECTRON DEVICE LETTERS, VOL. 33, NO. 5, MAY 2012 661

Ultrathin Body GaN-on-Insulator Quantum Well FETs With Regrown Ohmic Contacts

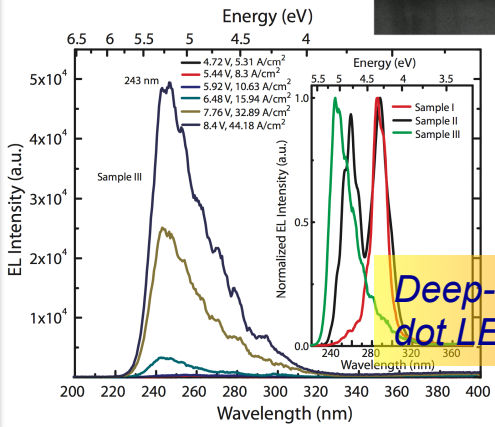
Guowang Li, *Student Member, IEEE*, Ronghua Wang, Jia Guo, *Student Member, IEEE*, Jai Verma, Zongyang Hu, Yuanzheng Yue, Faiza Faria, Yu Cao, Michelle Kelly, Thomas Kosel, Huili Xing, *Member, IEEE*, and Debdeep Jena, *Member, IEEE*

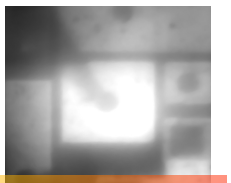
GaN on Insulator (AlN)



Hi-voltage GaN switches

Devices for Power Electronics

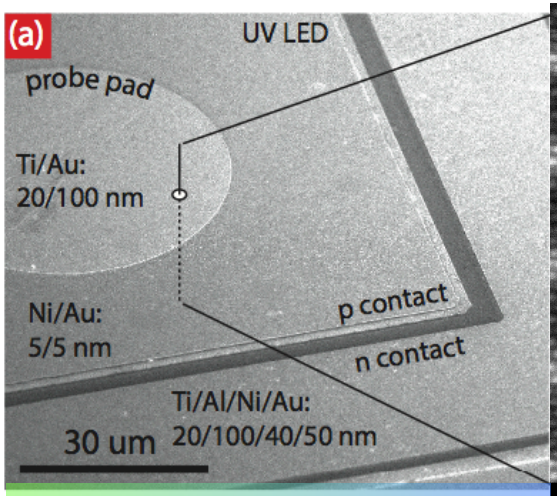




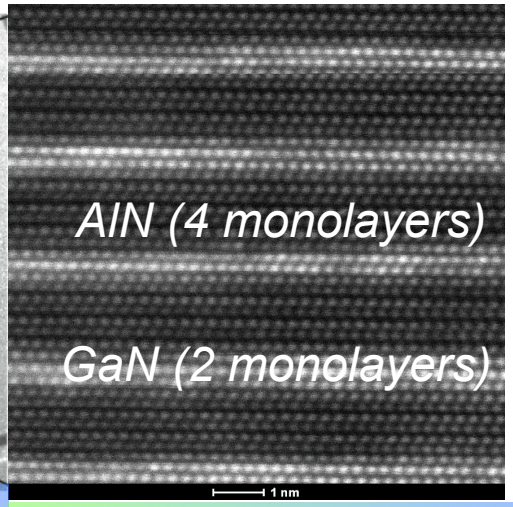
Deep-UV quantum dot LEDs

Debdeep Jena (djena@cornell.edu)

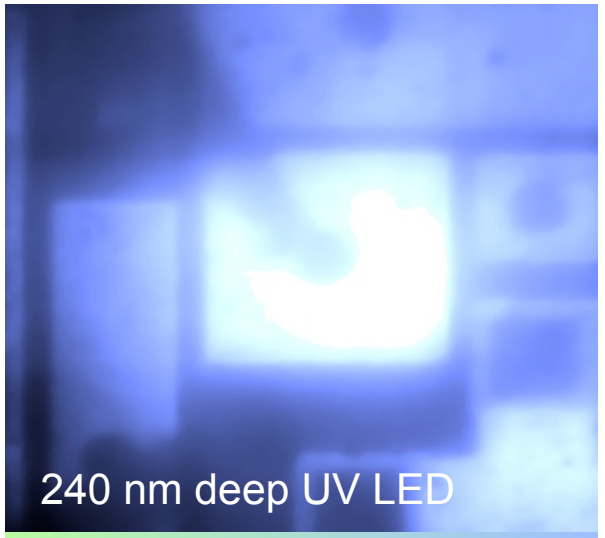
Extreme Bandgap Materials and Devices



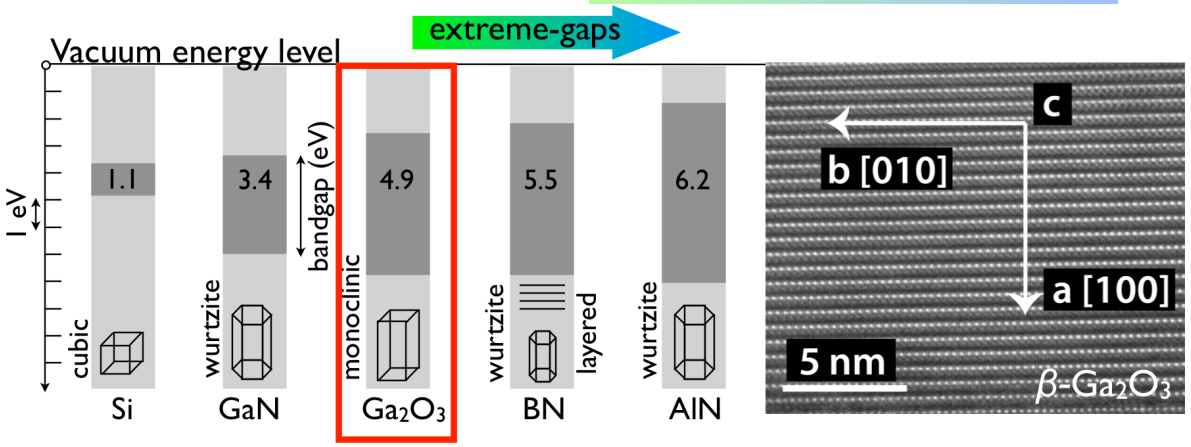
Nanofabrication



MBE growth with atomic level design and control



Photonic and electronic devices



Polarization-Induced Hole Doping in Wide–Band-Gap Uniaxial Semiconductor Heterostructures

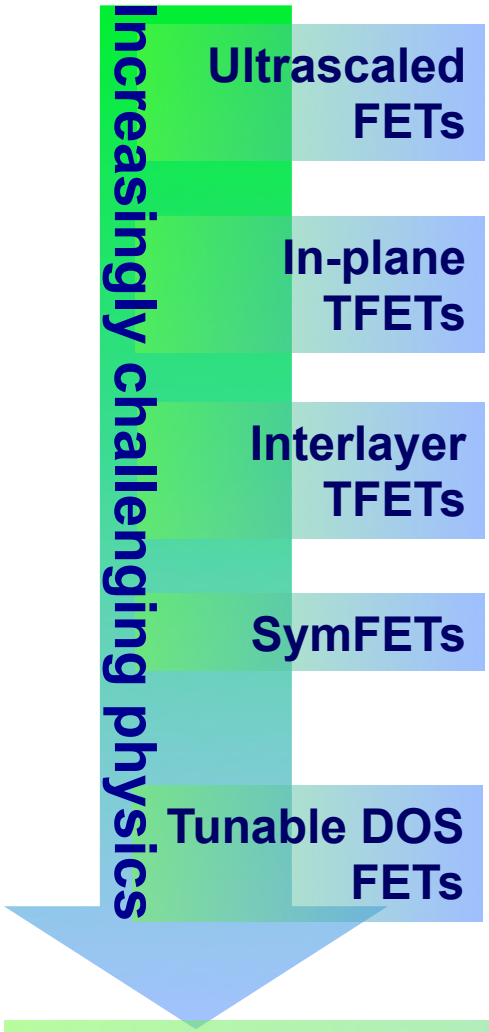
John Simon, Vladimir Protasenko, Chuanxin Lian, Huili Xing, Debdeep Jena*

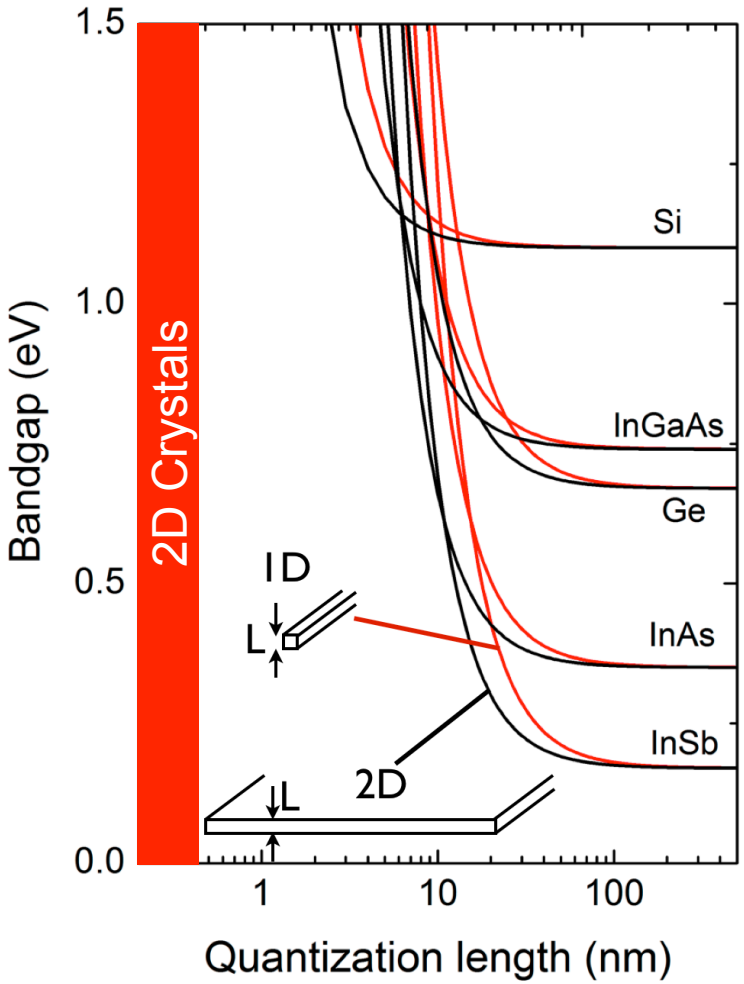
1 JANUARY 2010 VOL 327 **SCIENCE** www.sciencemag.org

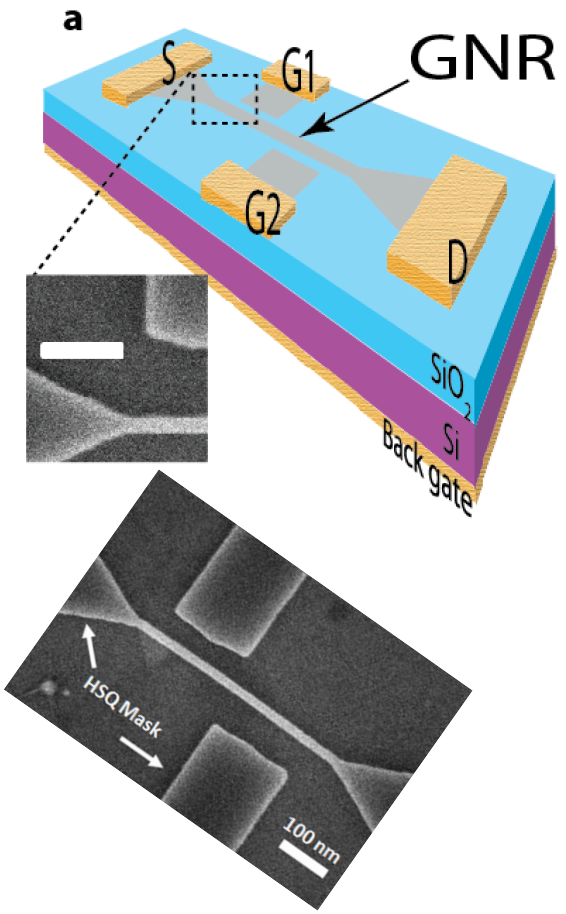
- *We are exploring next-generation extreme-gap semiconductor materials*
- *They are critical for energy, computation & communication applications in the next few decades*

Debdeep Jena (djena@cornell.edu)

2D Crystal Materials and Devices







- *We are exploring materials that will take us beyond the scaling of traditional semiconductors*
- *2D crystal materials: semiconducting, metallic, or superconducting – and remain atomically thin!*

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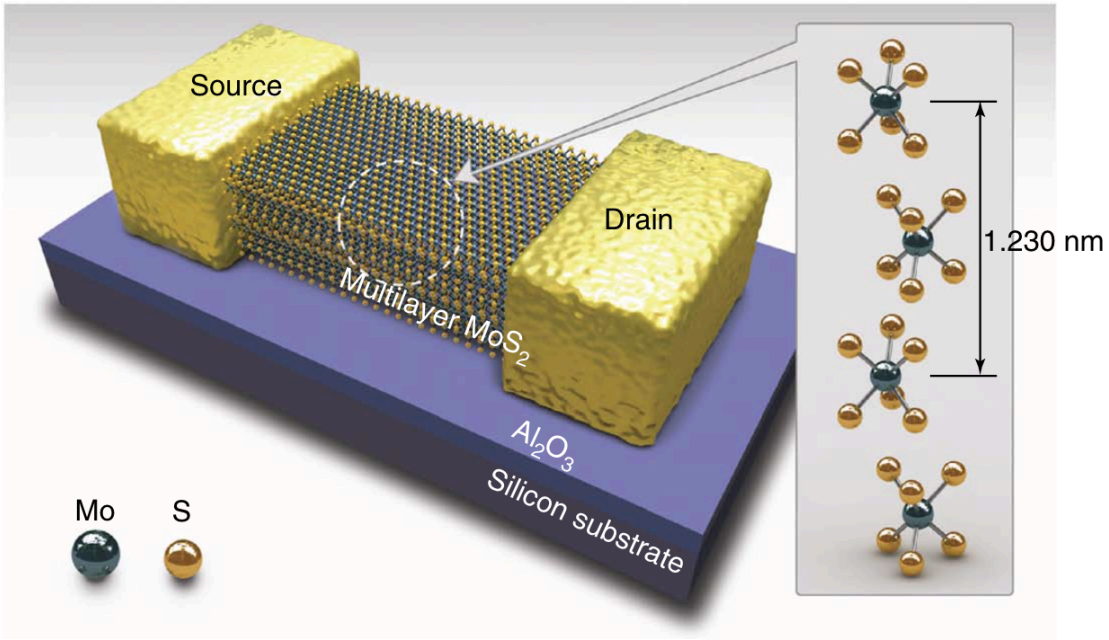
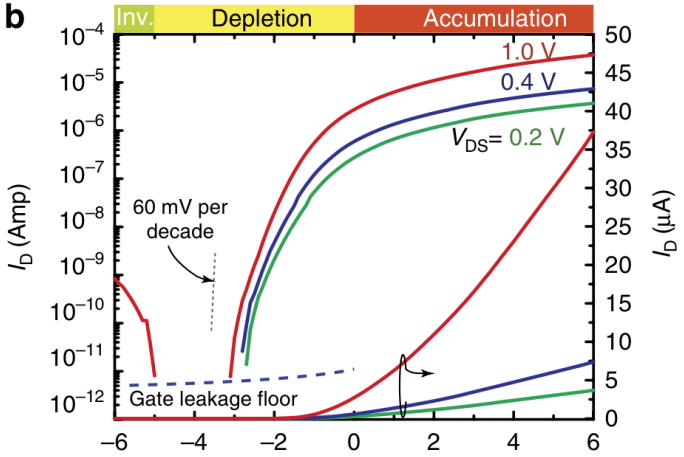
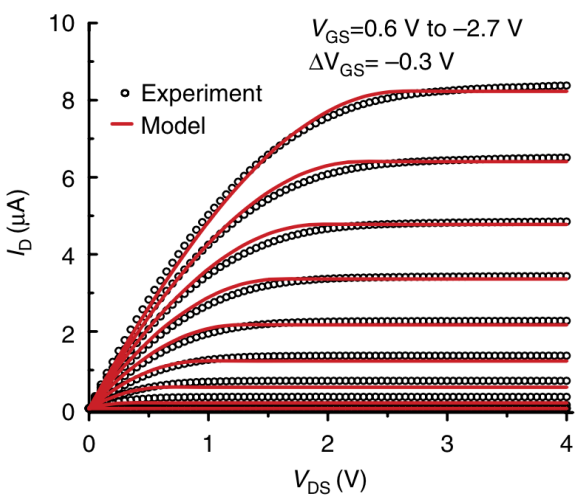
2D Crystal Materials and Devices







nature COMMUNICATIONS

ARTICLE

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High-mobility and low-power thin-film transistors based on multilayer MoS_2 crystals

Sunkook Kim[1,2], Aniruddha Konar[3], Wan-Sik Hwang[3], Jong Hak Lee[4], Jiyoul Lee[1], Jaehyun Yang[4], Changhoon Jung[1], Hyoungsub Kim[4], Ji-Beom Yoo[4], Jae-Young Choi[1], Yong Wan Jin[1], Sang Yoon Lee[1], Debdeep Jena[3], Woong Choi[1,5] & Kinam Kim[1]

- *Atomically thin semiconductor materials (Graphene, MoS_2, etc)*
- *Extensive growth, characterization of material structure, photonic, and electronic properties*
- *Demonstration of novel device functionalities*

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