Xiuling Li

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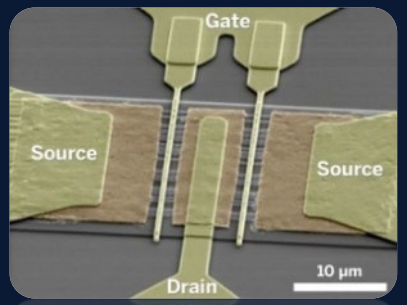
https://www.linkedin.com/in/xiuling-li-49a29945/

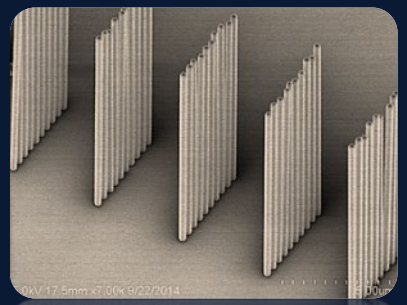
Research Interests:

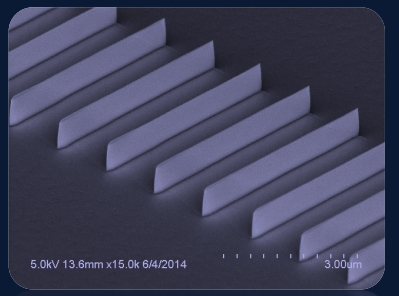
Nanostructured Materials and Devices

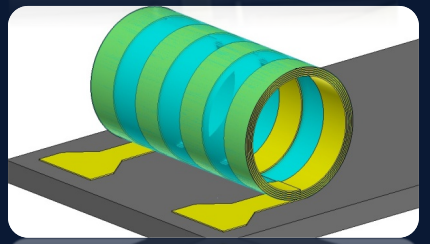
- Semiconductor materials and devices
- Nanotechnology
- Metal-assisted chemical etching (MacEtch)
- Self-rolled-up membrane (S-RuM)
- Metalorganic chemical vapor deposition (MOCVD)
- Wide and ultra-wide bandgap semiconductors
- III-N and β-Ga_2O_3
- III-V compound semiconductor
- Power electronics
- RFIC miniaturization
- van der Waals epitaxy of 2D TMDCs
- Nanoelectronics
- Nanophotonics
- Bionanotechnology

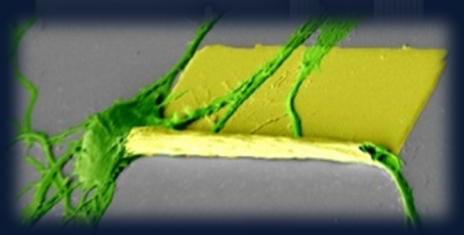


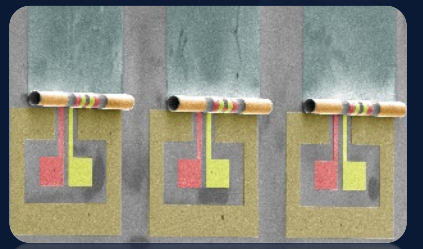
GaAs/AlGaAs NW HEMT


InAs nanowire on Si


InP FinFET


Rolled-up Inductor


guiding axon growth
by S-RuM


Rolled-up transformer

Current Projects

- ❑ Tunable III-nitride Nanostructures for N≡N and C-H Bond Activation (ARO MURI)
- ❑ β-Ga_2O_3 based electronics (NSF)
- ❑ S-RuM nanotech for miniaturization of passive electronic components (ERC, Illinois)
- ❑ S-RuM for DNA storage (SRC/NSF)
- ❑ MOCVD growth of III-V and III-N; soon Ga_2O_3.
- ❑ Metal-assisted chemical Etching of semiconductors

THE UNIVERSITY OF TEXAS AT AUSTIN

GOAL OF OUR RESEARCH:

to address the ever-present need of reducing the Size, Weight, Power, and Cost (SWaP-C) of devices.

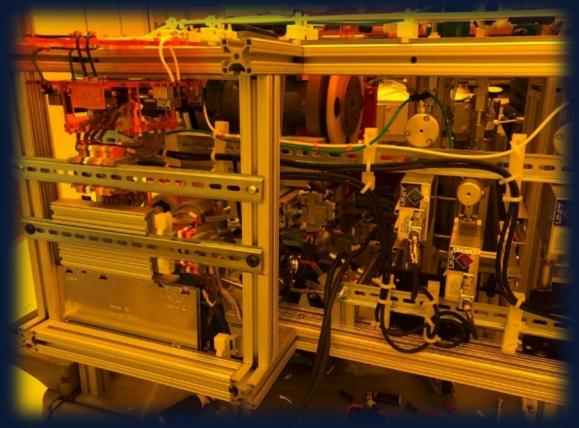
OUR APPROACH:

to create nanostructures that enable new device concepts and new science discoveries, in a compatible & scalable fashion.

Metal-assisted chemical Etching

Not Your Ordinary Etch

Defying text definition of chemical etch, MacEtch is an anisotropic, plasma-free, damage-free etching method that could potentially replace or improve dry etch for various electronics, photonics, energy, and bio-sensing applications.

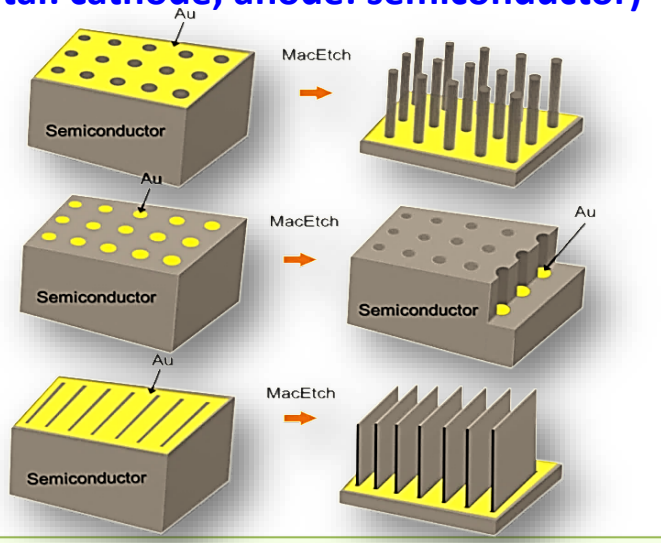


- Si
- Ge
- GaAs
- InGaAs
- AlGaAs
- InP
- GaN
- SiC
- Ga_2O_3
- Single
- Poly
- Amorphous
- junctions

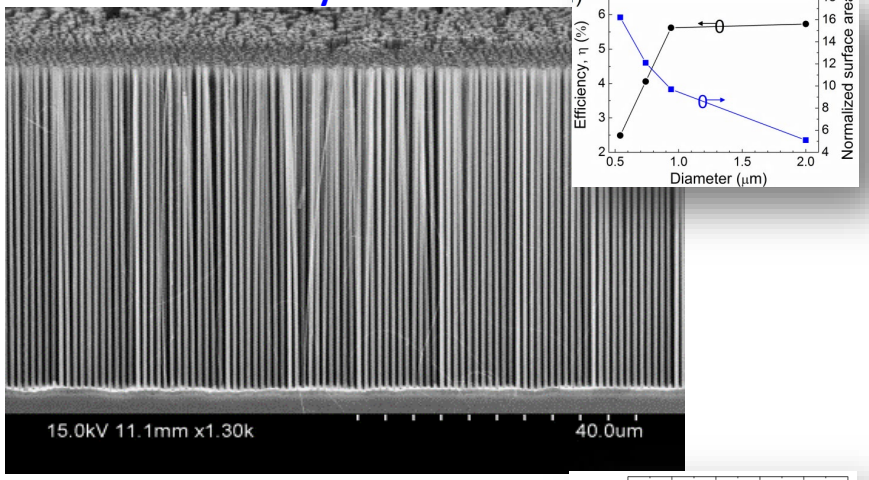
Metal-assisted chemical Etching (MacEtch) of Semiconductor:

Plasma-free, high aspect ratio, clean, versatile 3D nanostructures

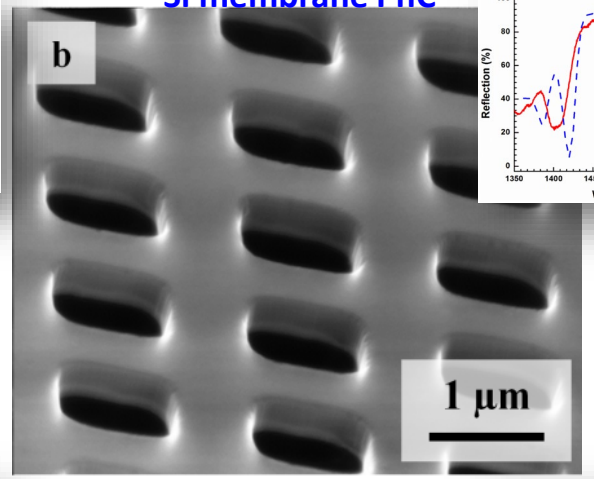
- **Variation**: *I*nverse-*MacEtch*, magnetic-field guided *h-MacEtch*, *SAC-MacEtch*, *UV-MacEtch*, *VP-MacEtch* (vapor phase)
- **Mechanism**: local electrochemical reaction (metal: cathode; anode: semiconductor)

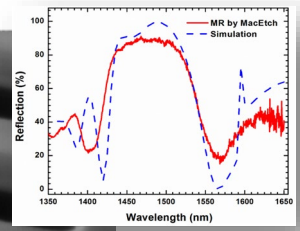


Si NW array: 100: 1 HAR

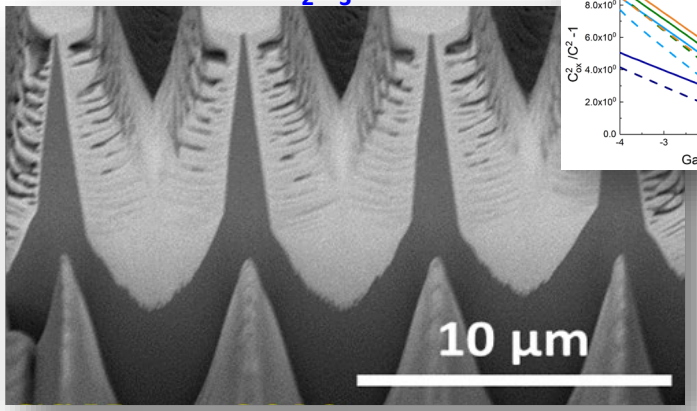


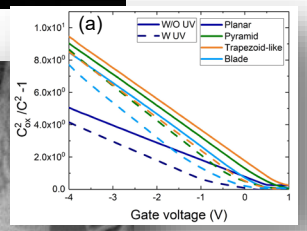
Si membrane PhC



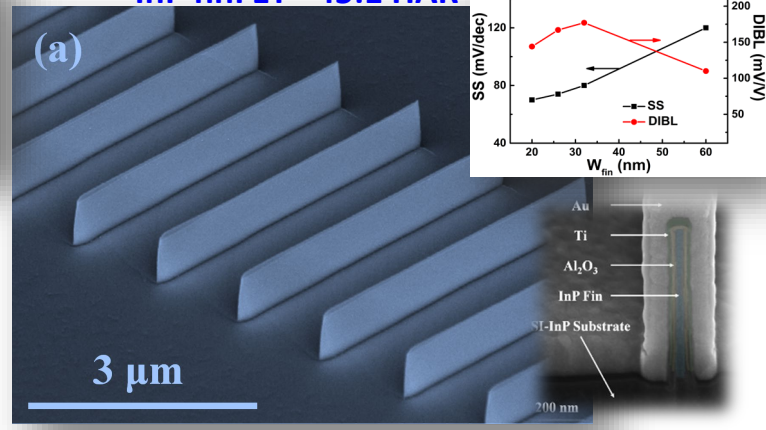


Beta-Ga_2O_3 MOSCAP





InP finFET - 45:1 HAR



- **Material versatility**: Si, Ge, III-As, III-P, GaN, SiC, Ga_2O_3 homo- hetero-junctions, single, poly

Selected Publications :

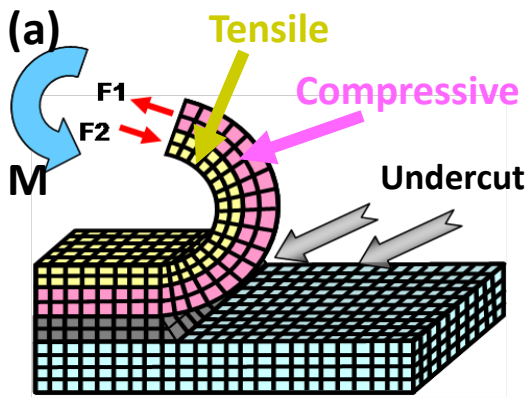
- *Li and Bohn, APL **2000**;*
- *Chun et al. APL, **2008**; Chern et al. Nano Lett. **2010**;*
- *DeJarld et al. Nano Lett. **2011**; Shin et al., IEEE J. Photovoltaics **2011**;*
- *Li, COSSMS, **2012 (review)**; Balasundaram et al. Nanotech. **2012**; Shin et al. Nanotech. **2012**;*
- *Mohseni et al. JAP, **2013**; Kim et al. Nano Lett. **2014**. Song et al. IEEE EDL **2016**.*
- *Kim et al. Adv. Func. Mater. **2017**; Kong et al. ACS Nano **2017**.*
- *J. Kim et al. ACS Appl. Mater. Interfaces **2018**, **2019***
- *M. Kim et al. ACS Nano **2018;***
- *Huang et al. ACS Nano **2019**.*
- *Michaels et al. Adv. Func. Mater. **2020**;*
- *Chan et al. J. Vac. Sci. Technol. A **2021**.*

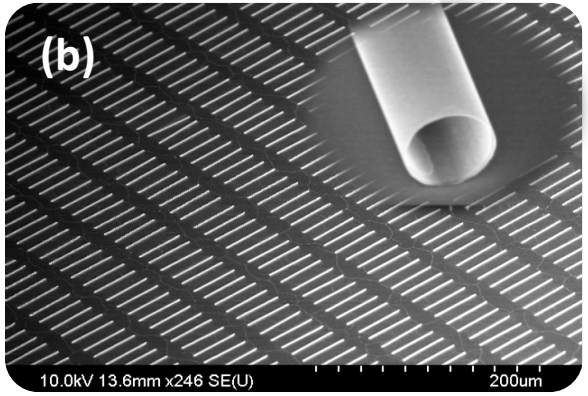
Self-rolled-up Membrane (S-RuM) Nanotechnology

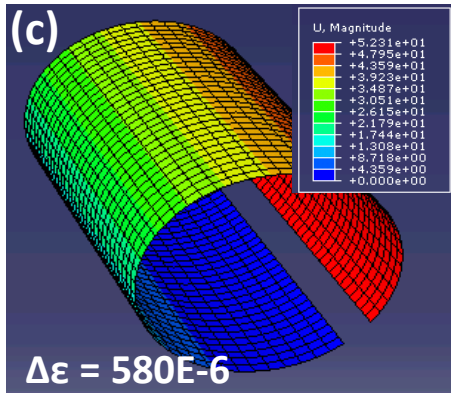
There is practically no limit upon the complexity or configuration of L-C circuits which can be made in the manner of S-RuM, all with one single lithography step.

Strain-induced Self-Rolled-up Membrane (S-RuM):

Extreme SWaP Electronics, Photonics, Plasmonics, and Neuron Cell Guidance and DNA storage



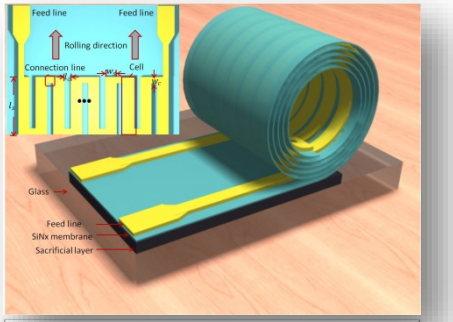


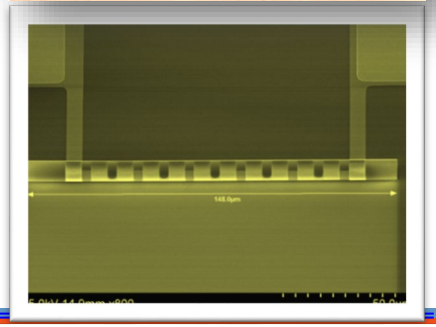


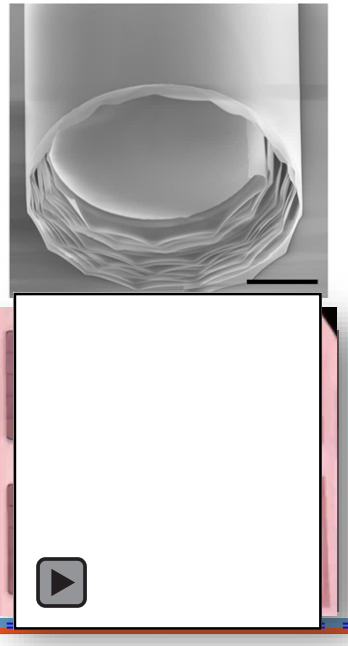
Related publications:

- *Chun and Li, IEEE Tnano, 2008; Li, J. Phys. D 2008.*
- *Chun et al. JCG, 2008; APL, 2010; Nano Lett. 2010.*
- *Miao, Chun and Li, Springer, 2011.*
- *Li, Adv. Opt. Photonics, 2012.*
- *Huang et al. Nano Lett. 2012; Nano Lett. 2014.*
- *Froeter et al. Nanotech 2013; ACS Nano 2014.*
- *Yu et al. Sci. Rep. 2015; APL 2015.*
- *Huang et al. Nature Electron. 2018.*
- *Michaels et al. Adv. Mater. Interfaces 2019.*
- *Sang et al. Nanotech 2019.*
- *Huang et al. Science Advances 2020.*
- *Yang, Kraman, et al. Adv. Func. Mater. 2020.*

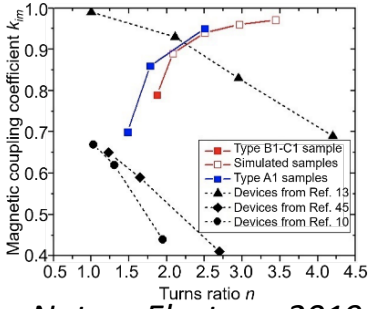
Applications:
inductor, capacitor, transformer, neuron cell growth, DNA storage





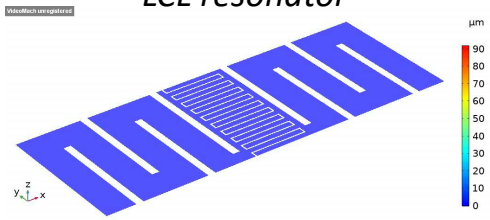


• *Science Adv. 2020.*

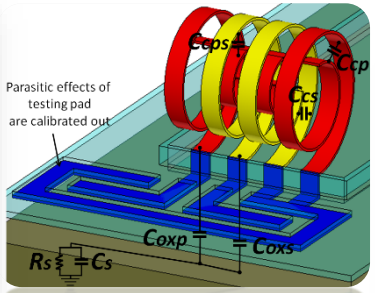


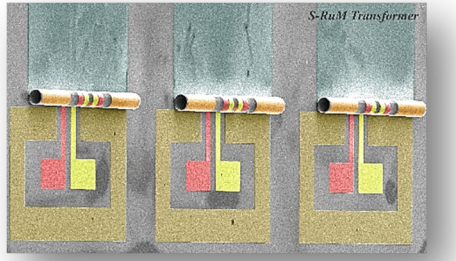
• *Nature Electron. 2019.*

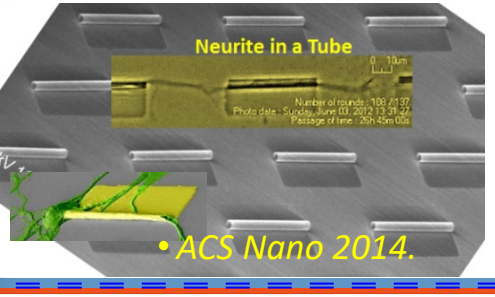
• *LCL resonator*



• *AFM 2020.*







• *ACS Nano 2014.*

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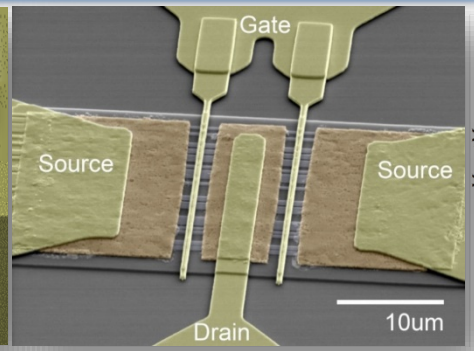
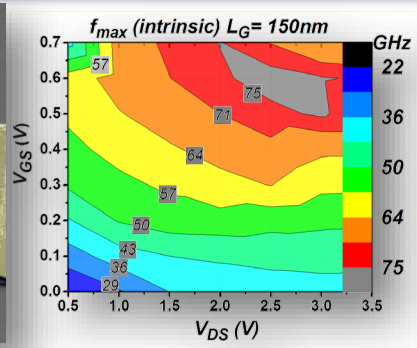
MOCVD Broad Area and Selective Epitaxy

By developing new epitaxial growth concepts and paradigms, we have created and will continue to explore new device architectures to enable advanced performance.

III-V Nanowires: towards High Performance Electronics and Quantum Technology

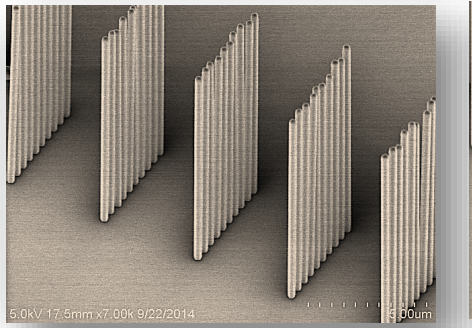
MOCVD selective lateral epi: self-aligned, defect-free, transferable, monolithic 3D HMET

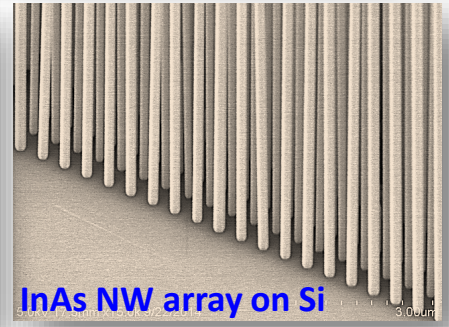




Fortuna et al. Nano Lett. 2005; EDL 2009; Miao et. al. EDL 2011; Nano Lett. 2013; 2015; Zhang et al. Nano Lett. 2014, EDL 2015.

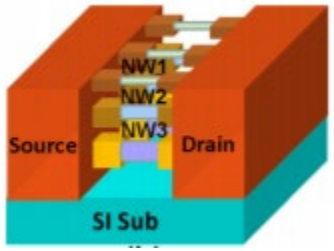
Heterogeneous integration of III-V NW on Si

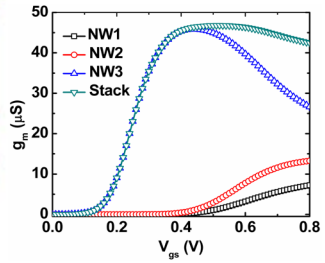




Bassett et al. APL 2015; Mohseni et al. unpublished.

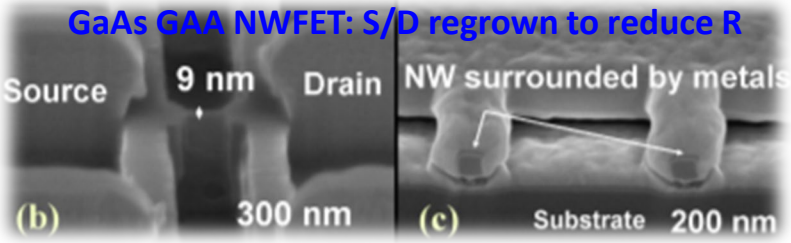
III-V NWFETs: GAA vertical stack





Song et al. APL 101, 093509 (2012)

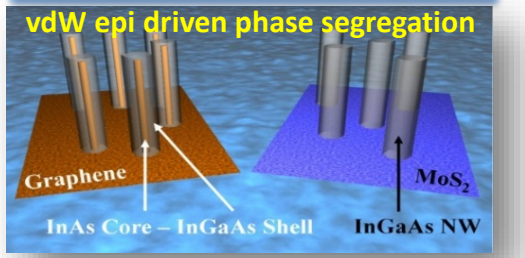
GaAs GAA NWFET: S/D regrown to reduce R

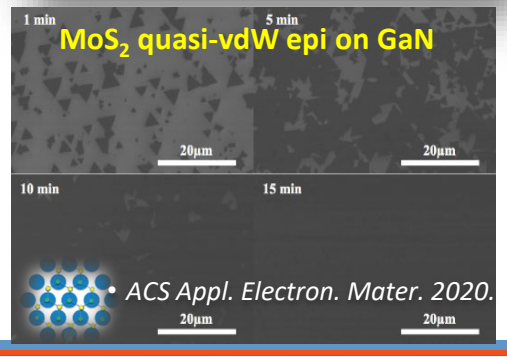


Song et al. EDL 35, 324 (2014).

vdW epi: III-V/2D

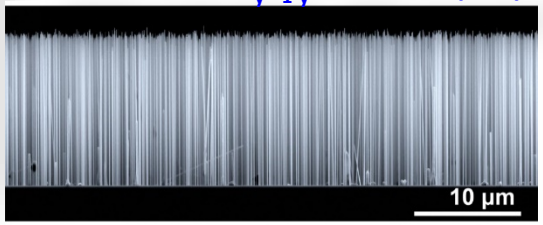
vdW epi driven phase segregation



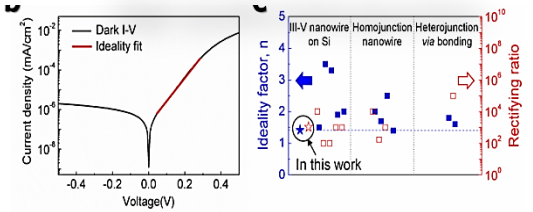


Seed-free, pattern-free direct epitaxy

Wafer-scale $InAs_yP_{1-y}$ NWs on Si (111)

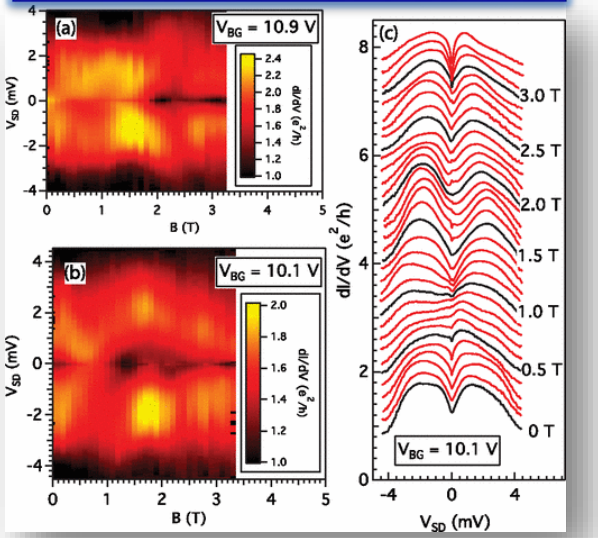


High quality heterojunction



• Nano Lett. 2011; ACS Nano, 2012, 2013.

InAs NW-NbN: hybridizing Majorana fermions



Finck et al. Phys. Rev. Lett. 110, 126406 (2013).