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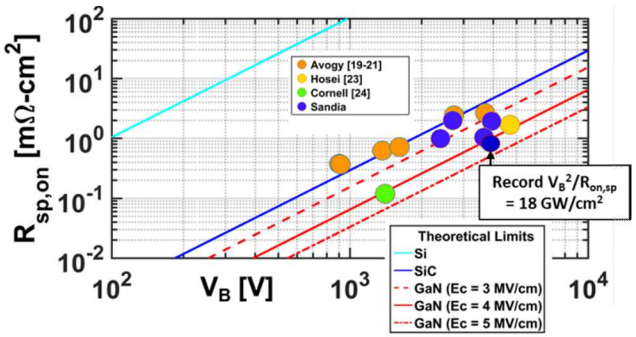

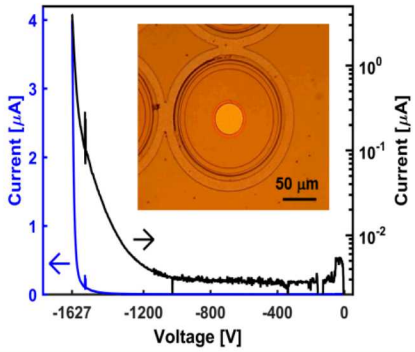

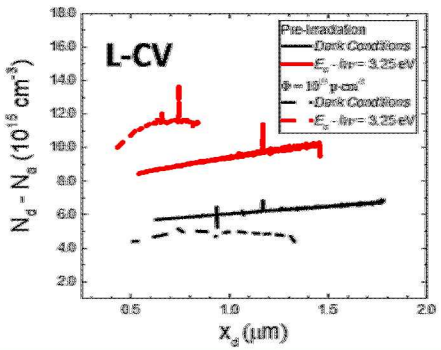

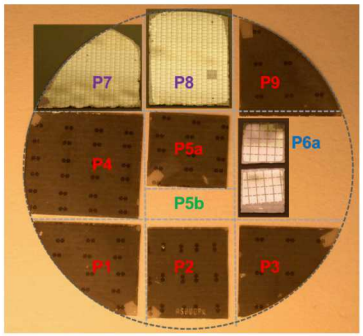

1876/1873 Departments
Wide Bandgap Materials and Devices

Bob Kaplar and Paul Sharps

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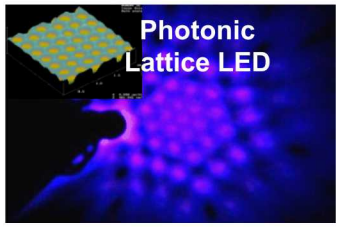
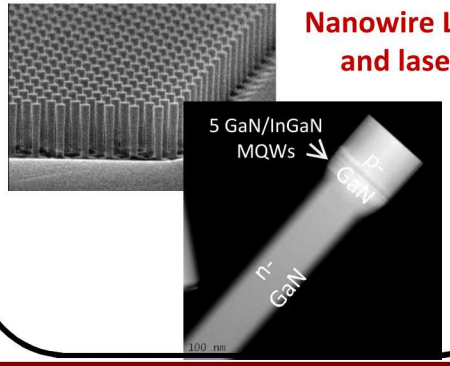
Sandia Wide Bandgap Semiconductor Materials and Device Research (1996-2018)

Visible Optoelectronics (Solid-State Lighting)

-GC LDRD 2000-2004; DOE EERE 2005-2013, EFRC 2010-2014

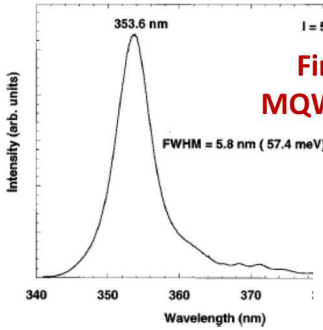
Filling the LED "green gap" in LED efficiency





Nanowire LEDs and lasers

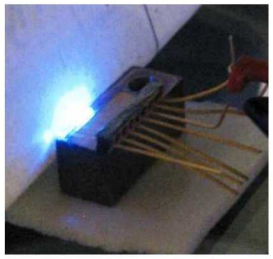
Ultraviolet Optoelectronics



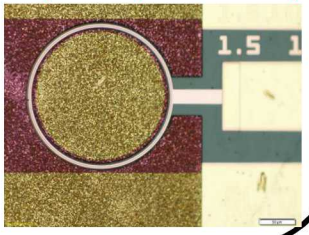
First AlGaN MQW LED (1998)

280 nm LED arrays for NLOS comm. link

Deep UV LDs ~ 350-360 nm

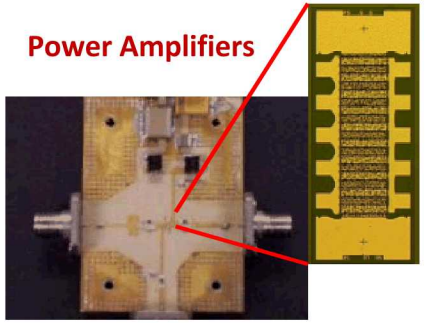


UV Detectors (visible/solar-blind)

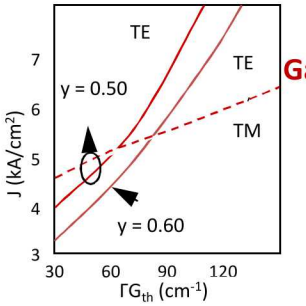


Power Electronics

Power Amplifiers

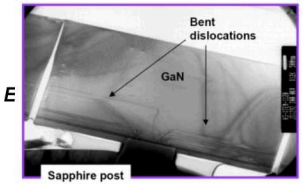


Advanced Modeling and Characterization

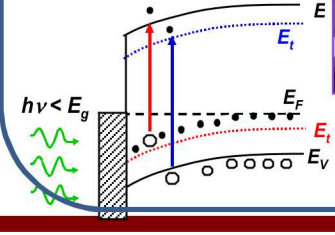


Gain modeling/many-body physics of of nitride lasers

Transmission electron microscopy



Defect Spectroscopy

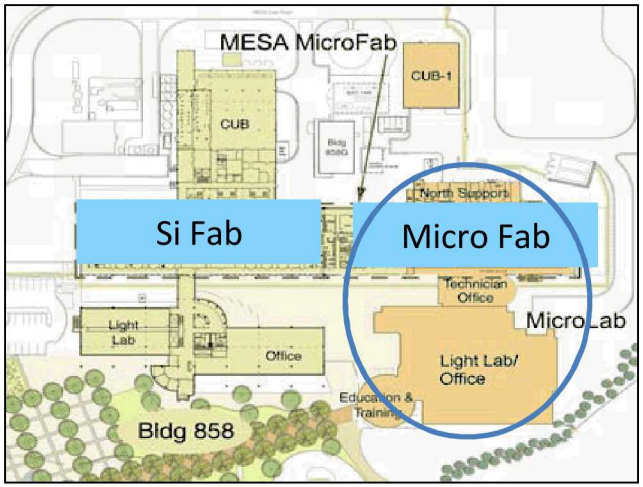


Sandia History and Capabilities

Sandia History in Electronics, Optoelectronics, Photonics, MEMS, and Microsystems

- 60+ years as DOE/NNSA mission lead in electronics
- 35+ years of compound semiconductor research
- 20+ years of wide-bandgap materials & device R&D

- Application-Specific Integrated Circuits (Si) and Heterojunction Bipolar Transistors (GaAs) produced for insertion into NNSA systems

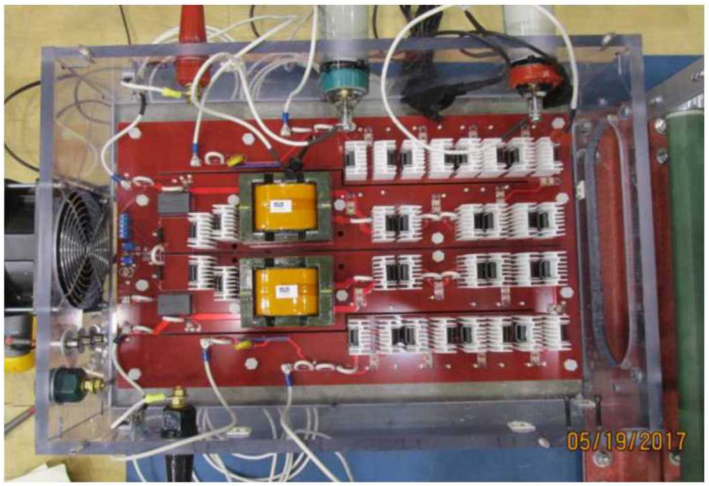


MESA Microfab (858EF):

- 9,400 ft^2 cleanroom space
- Epitaxial growth
- Device processing
- Associated light labs (858EL)

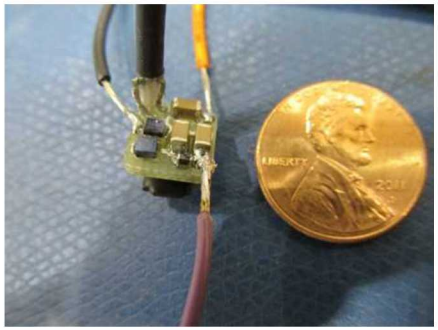
Trusted Foundry: TRL 1-9

Wide Band Gap and Ultra WBG Power Electronics



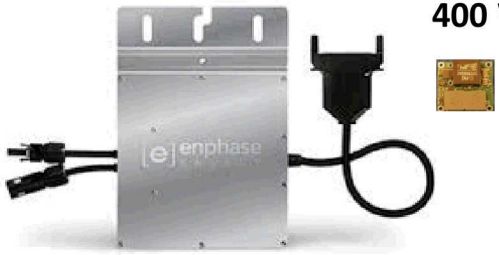
SNL SiC hybrid switched-capacitor boost converter (ARPA-E)

- First prototype: 0.5 kV → 10.1 kV (gain = 16.8) at 2.6 kW, 95.3% efficient, 410 in^3
- Second prototype: +2% efficiency, 55% volume



SNL GaN HEMT "Coin Converter"
90 V, 90 mA → 215 W/in^3

SNL GaN HEMT micro-inverter
400 W in 2.4 in^3 → 167 W/in^3



SOA commercial micro-inverter
250 W in 59 in^3 → 4.2 W/in^3

Over an order of magnitude improvement in power density is enabled by WBG and UWBG semiconductors compared to Si