SAND2020-0094C

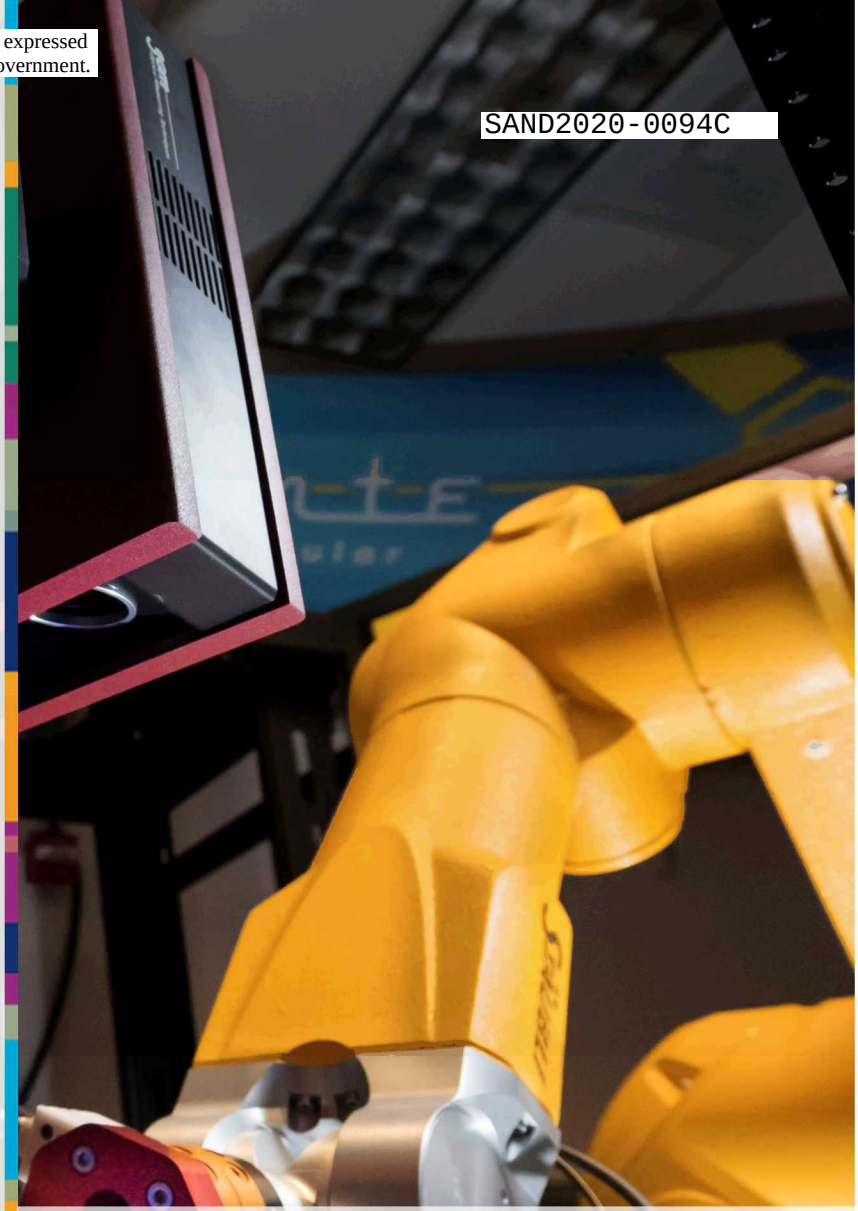
Research Spotlight Forum

1.7.2020 | Advanced Manufacturing

Heterogenous Integration at Sandia's MESA Facility

Michael Wood (micwood@sandia.gov)

Optoelectronics and Integration



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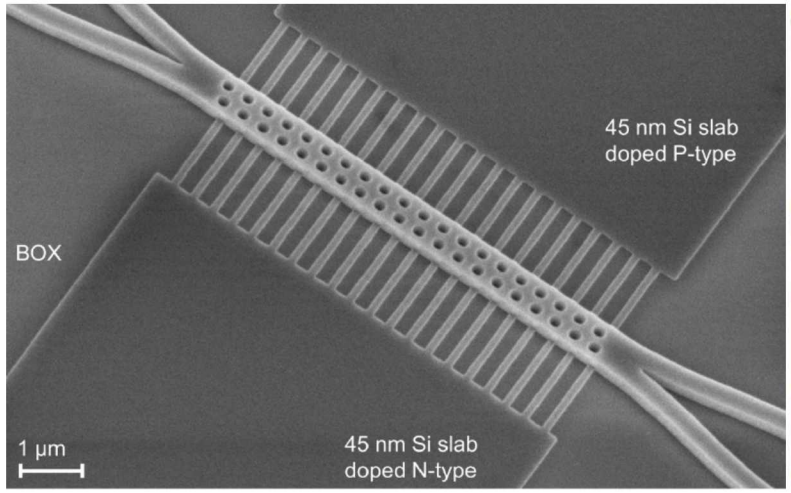
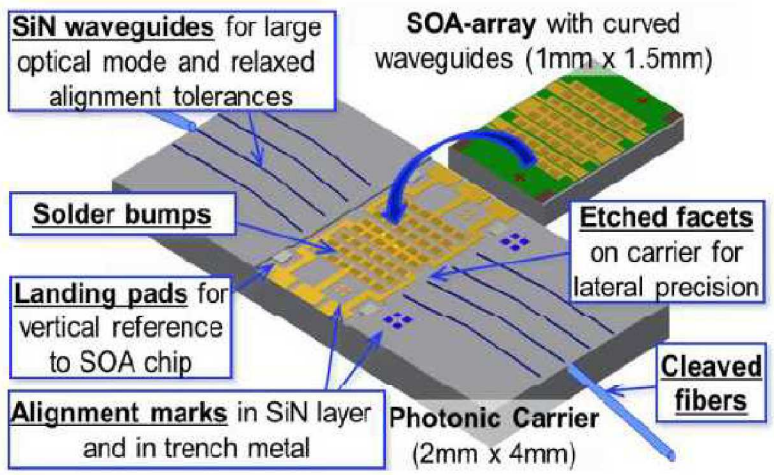
ABOUT YOURSELF

Before Sandia

- PhD (Ohio State) work on efficient Si photonic modulators including integration of $LiNbO_3$ thin films
- Integration of III-V gain elements with Si photonics at IBM



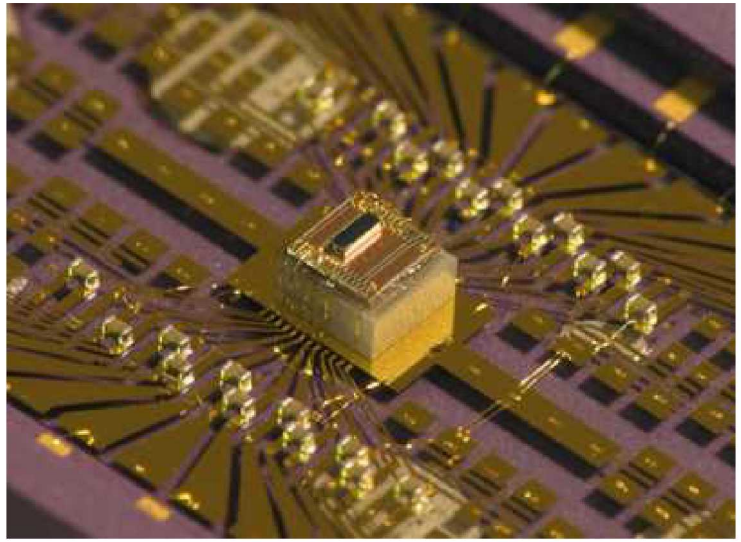
M. Wood, Opt. Exp., 23481 (2016)



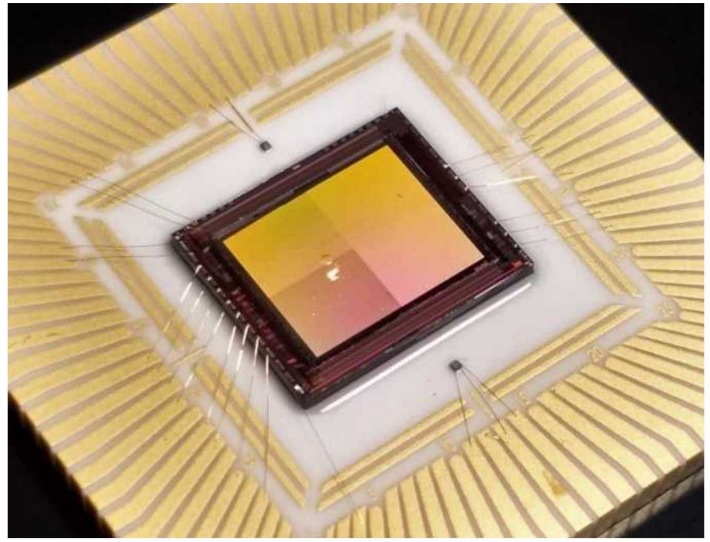
L. Schares, OFC, Th3F.5 (2016)

At Sandia

- Work within the Microsystems Engineering, Science and Applications (MESA) complex
- Development of III-V and Si-based optoelectronic microsystems: focal plane array, optical and x-ray detectors, optical transceivers, photovoltaics,…



Integrated VCSEL and CMOS driver



Long-wave IR metamaterial FPA

Keywords: Optoelectronics, photonic integrated circuits, FPAs

CAPABILITES FOR ADVANCED MANUFACTURING

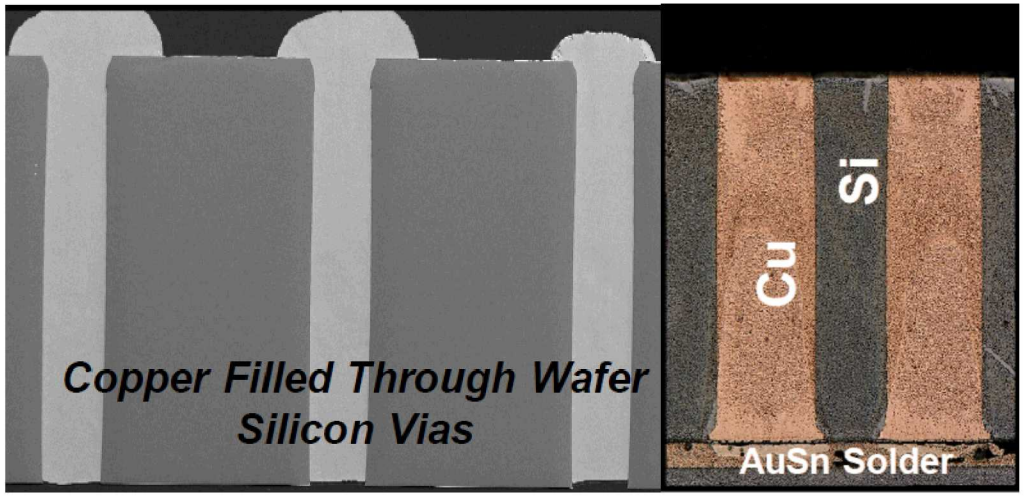
In-house back-end processing:

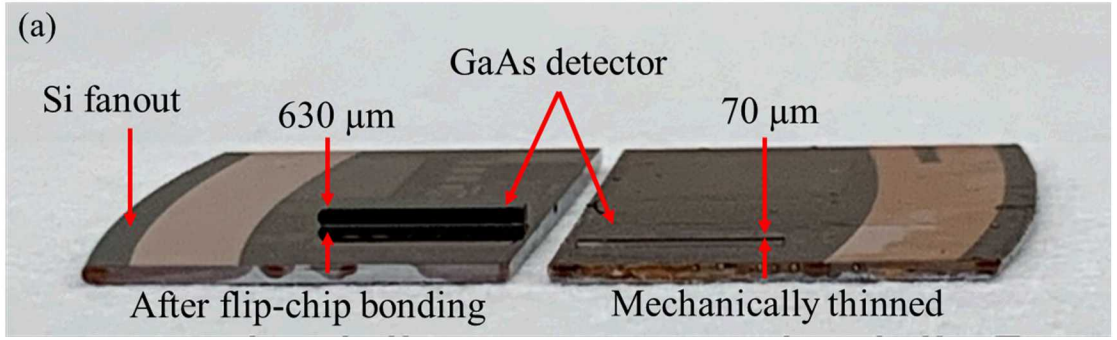
- In bump deposition and reflow
- Solder ball jetting
- Metal plating of through-substrate vias

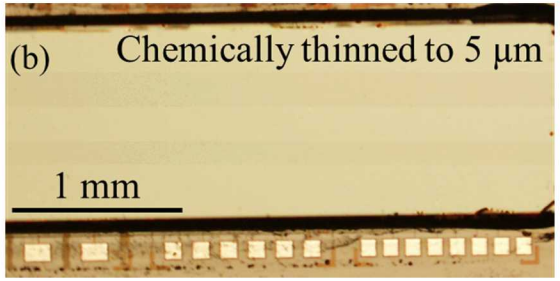
Integration capabilities:

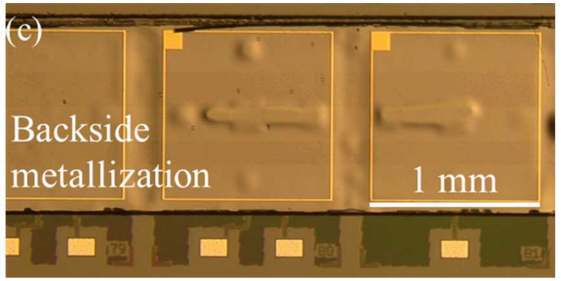
- Flip-chip and wafer bonding
- Post-bond substrate removal
- Automated wire bonding
- 3D printing

Semi-automated flip-chip bonder







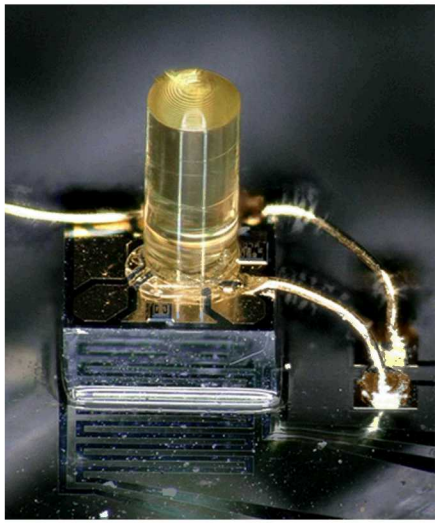


CURRENT WORK IN ADVANCED MANUFACTURING

Interested in expanding role of AM optics

- Two projects (with Bryan Kaehr) on printed optics
- Lithographically-aligned lenses, fiber couplers, and waveguides can lead to production of complex photonic microsystems at relevant scales
- Work needed to develop materials, improve processing, and study robustness to environments

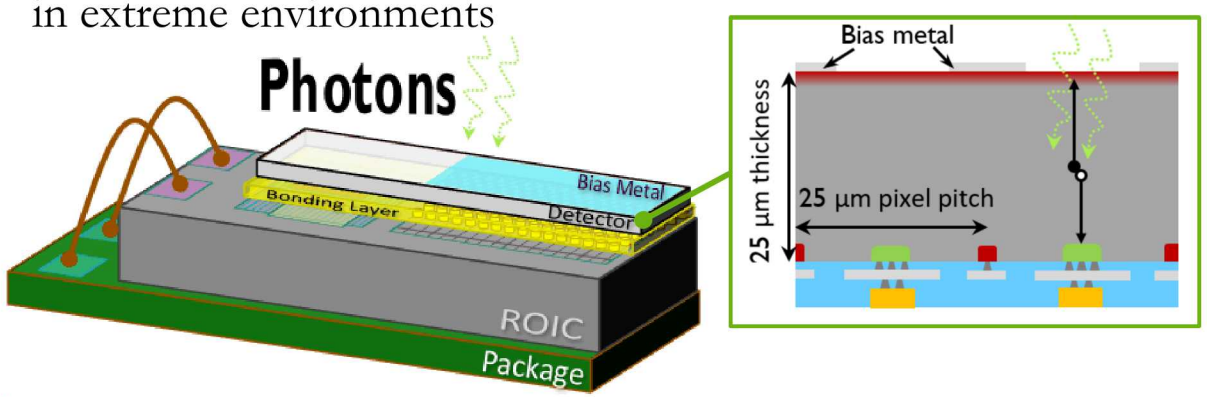
3D printed fiber holder and collimating lens



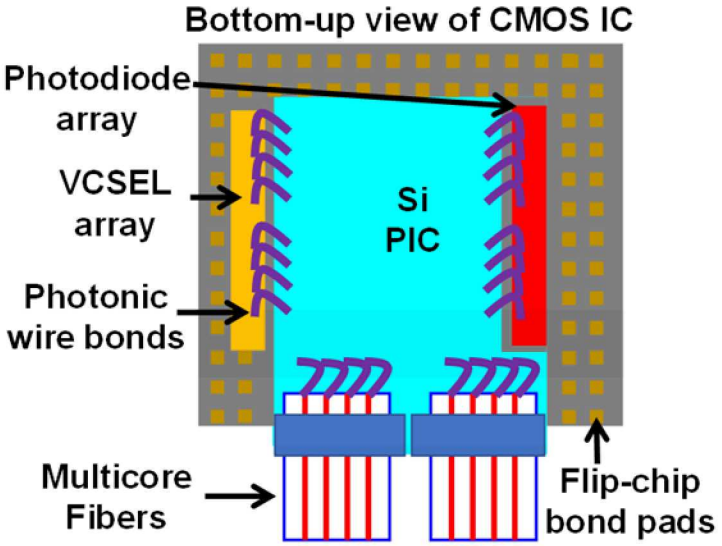
3D printed micro-lens on a VCSEL

III-V sensors for hard x-ray FPAs

- Scaling recent success on single-pixel GaAs hard (>10 keV) x-ray detectors to megapixel-scale imaging arrays
- Producing full-scale test arrays this FY; interested in learning more about interconnect metallurgy and impact on reliability in extreme environments



Concept of III-V and Si-based PIC photonic transceiver; all optical interconnects 3D printed



FUNDING SOURCES

DOE/NNSA
Direct funding and via LDRD program
Supports most early R&D work

DARPA MTO
PIPES (photonic transceiver)
ACES (VCSELs for atomic clocks)

DOD
Funding for multiple III-V microsystem programs