SUMMARY:

- BU Presentation – Institute for Manufacturing Innovation
  - Focus on: areas where US has a lead or can quickly establish a lead, areas that will benefit from industry/government/non-profit collaboration and investment, areas with dual defense and commercial applications
  - Focus Areas: Biophotonic materials and instruments, adaptive optics and imaging, high power fiber lasers
- Breakdown of each areas (slides 5-8)
  - BU Strengths: Biosensing and imaging, neurophotonics, adaptive optics, fiber lasers

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BU Photonics Center

Institutes for Manufacturing Innovation

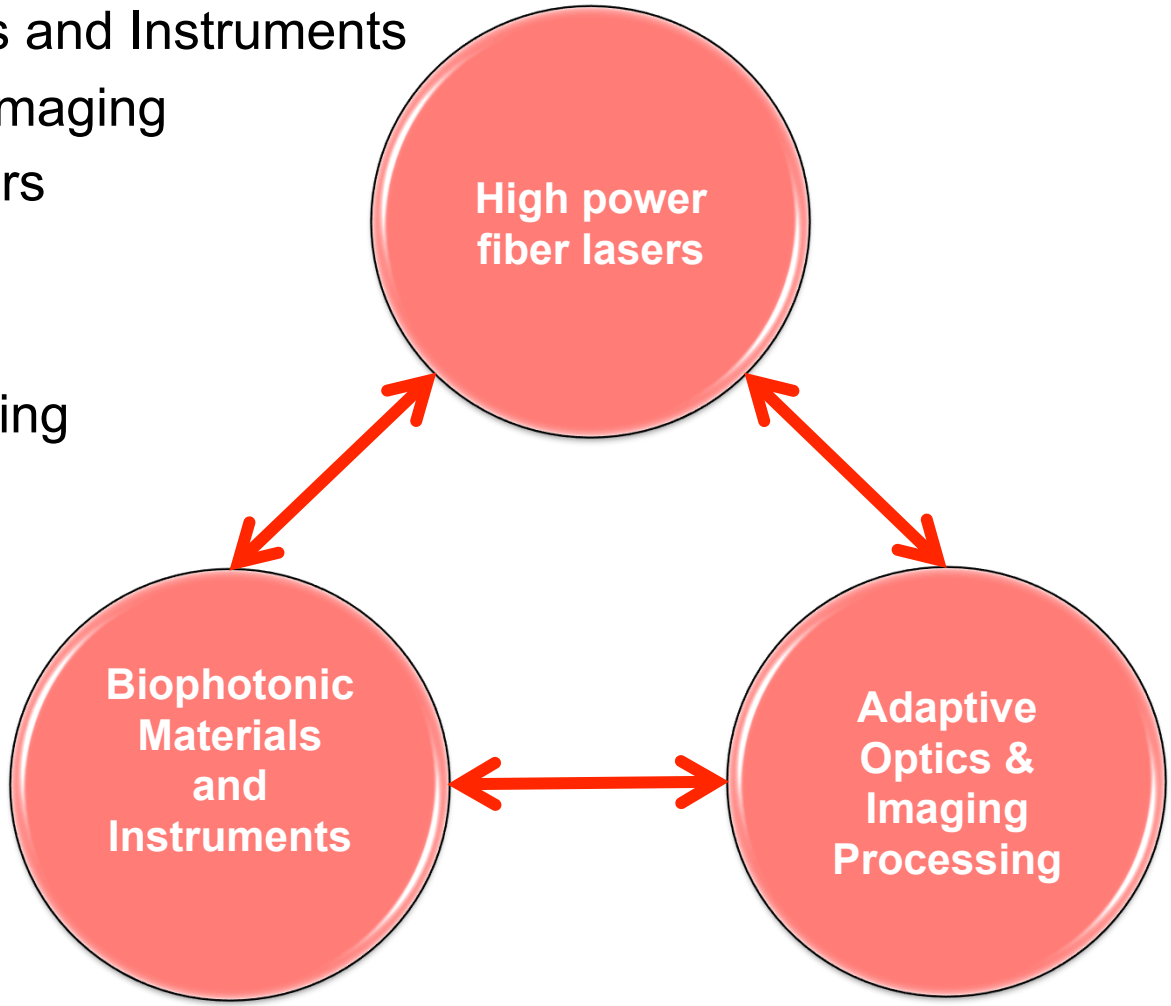
- Focus on:
  - Areas where the US has a lead or can quickly establish a lead.
  - Areas that will benefit from joint industry/government/non-profit collaboration and investment.
  - Areas with dual defense and commercial applications.

- Competitive in strategic areas:
  - Eg, Brain Research through Advancing Innovative Neurotechnologies (BRAIN) initiative

Focus Areas:

- Biophotonic Materials and Instruments
- Adaptive optics and imaging
- High power fiber lasers

- Strengths @ BU:
- Biosensing and Imaging
- Neurophotonics
- Adaptive Optics
- Fiber Lasers



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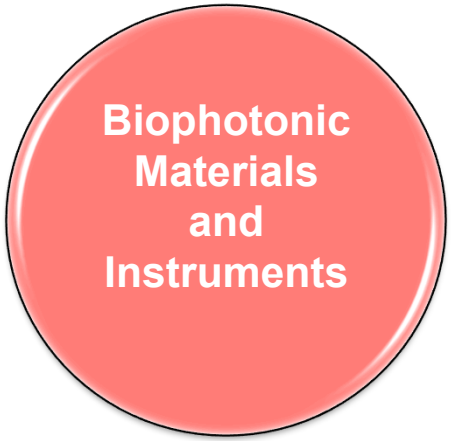
Manufacturing – some thoughts

- Innovation driven technology
- Manufacturing vs. rapid prototyping
  - Large corporation vs start-ups
- Foundry for optical microsystems
- Modular components – optical lego
  - Spindler&Hoyer -> ThorLabs
- Optical fiber sources with a catalog of parameters
- Beam shaping
- Sensors
- Quality control for nanophotonics

Enables embryonic field of Neurophotonics / Optogenetics

Toolkit for:

- Light induced activation of neuronal signals
- Light induced silencing of nerves
- Indicators for light-based sensing of neuronal signals



Applications/Potential

•Vision restoration
•Treatment of neurological disorders/ injuries (strokes, addiction, epilepsy, TBI, Parkinson's, Alzheimer's, etc.)
•Biomimetic memory elements in all optical processing

US Position vs. ROW

- Leader in optogenetic research and biophotonic protein development

Issues to be addressed

•Production techniques for manufacturing families of proteins activated/inactivated at different wavelengths
•Processes to deliver optogenetic actuation/ sensing proteins to specific neural pathways and circuits
•Develop proteins for "rewritable" and "non-rewritable" applications and techniques to synthesize in volume
•Characterization tools

Existing Equipment/Design Tools

- At universities that have taken research lead (i.e. Stanford, MIT, Boston Univ.)

Current Foundries:

- None

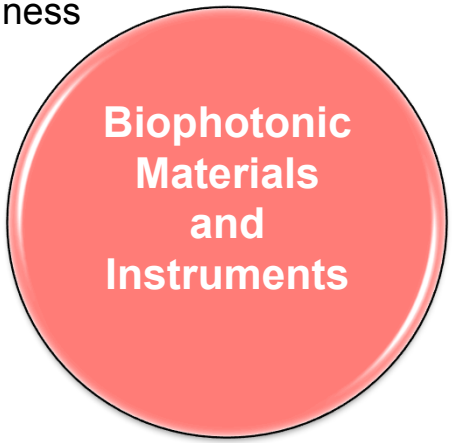
Enables Biosensors

Technology development / prototyping

- Advanced technology innovation at the cross-section of nanotechnology and photonics
- Pipeline for rapid prototyping and business development

US Position vs. ROW

- Leader in diagnostic technology
- Stiff competition from Europe and China with varying regulatory hurdles



Applications/Potential

- Infectious diseases
- Cancer
- Biomarker discovery

Issues to be addressed

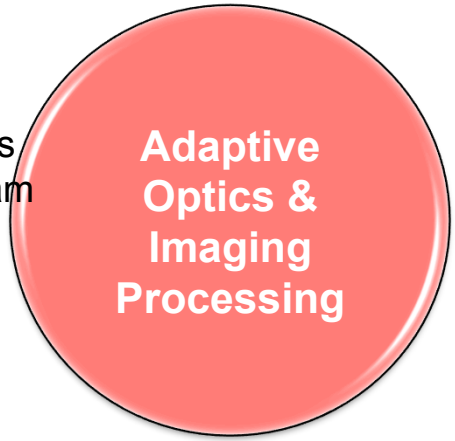
- Idea to benchtop to clinic
- partnering with medical research
- NSF-NIH boundaries

- UC Davis STC

Several uniquely defense applications that involve adaptive optics in wave-front sensing and control, but also cross-over commercial applications

Defense Applications

- Earth based tracking of satellites
- Imaging or communication through fog, smoke or distances
- Stand-off sensing for chemical or biological pathogens
- High energy laser weapon systems
- Control of optical elements for beam steering (anti-missile defense)



Commercial Applications

- Healthcare:
  - Imaging deep in tissue
  - Ophthalmic retinal imaging systems
- Control of industrial lasers in applications like precision lithography systems
- Improving cameras and other commercial applications
- IC failure analysis

US Position vs. ROW

- Innovation lead, but lack optical MEMS foundry capability
- MEMS foundries have succeeded, but not in the more complex domain of optical microsystems

Issues to be addressed

- Production facilities need to be capable of volume manufacturing but also allow customization and fast prototyping.
- Flexible manufacturing line with library of processes for customization
- Design tools compatible with manufacturing processes
- Wafer level testing of custom devices
- Partnering with UC Santa Cruz STC

Existing Equipment/Design Tools

- Builds on standard semiconductor equipment

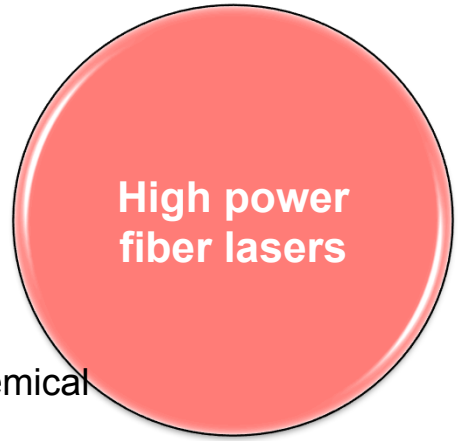
Current Foundries:

- Two European companies for optical MEMS (one w/ foundry in NC)

Commercial sector leads the way due to the strength of the optical amplifiers for the telecom sector

Advantages

- Compact
- Rugged
- Strong manufacturing infrastructure



Applications/Potential

- Stand-off systems for biological/chemical defense
- High energy laser weapons systems
- Industrial in fabrication, cutting, welding, machining
- Multiphoton imaging systems

US Position vs. ROW

- Leadership in manufacturing
- Unsure about position in lasers for defense applications

Issues to be addressed

- Investigate non-conventional fiber modes (Bessel-like fiber modes) and other techniques that will optimize for wide tunability and high power
- Sourcing of gain dopant materials
- Standardization of control systems

Existing Equipment/Design Tools

- Existing infrastructure that supports high volume fiber amplifier production used in communications applications
- Unsure if necessary to leverage government funds

Current Foundries:

- Capacity in the telecom industry

Thank you