

# About Omics Group

**OMICS Group** International through its Open Access Initiative is committed to make genuine and reliable contributions to the scientific community. **OMICS Group** hosts over 400 leading-edge peer reviewed Open Access Journals and organize over 300 International Conferences annually all over the world. OMICS Publishing Group journals have over 3 million readers and the fame and success of the same can be attributed to the strong editorial board which contains over 30000 eminent personalities that ensure a rapid, quality and quick review process.

# About Omics Group conferenc

- **OMICS Group** signed an agreement with more than 1000 International Societies to make healthcare information Open Access. **OMICS Group** Conferences make the perfect platform for global networking as it brings together renowned speakers and scientists across the globe to a most exciting and memorable scientific event filled with much enlightening interactive sessions, world class exhibitions and poster presentations
- Omics group has organised 500 conferences, workshops and national symposium across the major cities including SanFrancisco, Omaha, Orlando, Raleigh, SantaClara, Chicago, Philadelphia, Unitedkingdom, Baltimore, SanAntanio, Dubai, Hyderabad, Bangaluru and Mumbai.

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# Magnetic and Electronic Fibers

**Daniel Homa and Gary Pickrell**  
**Virginia Tech**

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2<sup>nd</sup> International Conference and Exhibition on

**Lasers, Optics & Photonics**

September 08-10, 2014 Hilton Philadelphia Airport, USA

# Introduction

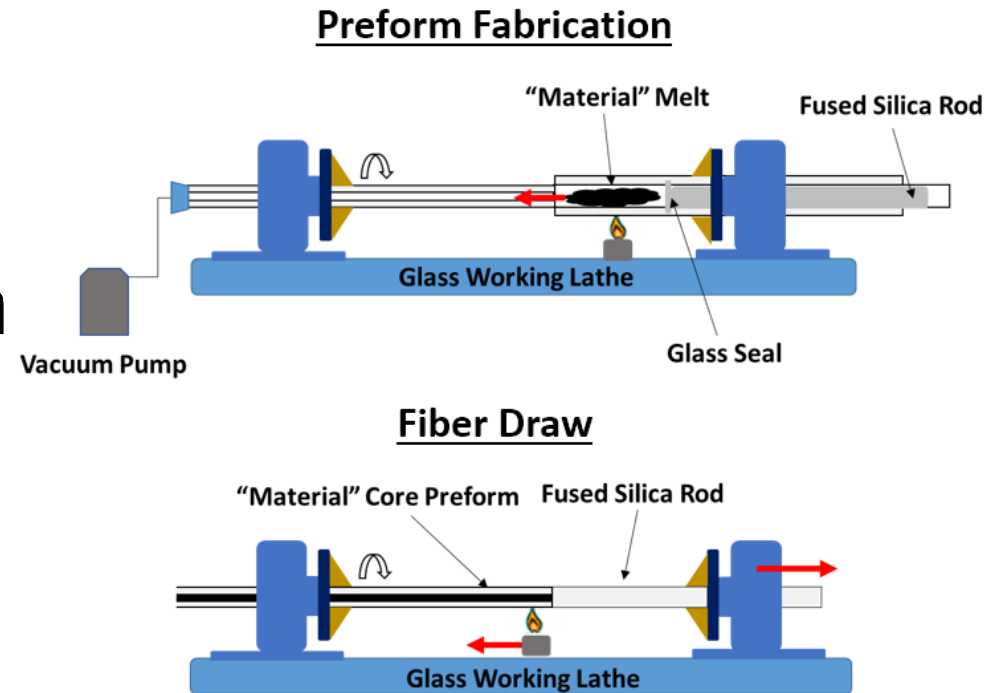
- **Fiber Optics**
  - Long-Haul Communications, Sensors
  - Proven Materials and Processing Techniques
- **Complementary Technologies**
  - Electronic Devices, Photo-detectors, Amplifiers, etc.
  - Stimuli-Responsive Materials
- **Integration**
  - Multiple Functionality
  - Miniaturization

# Motivation

- **All-Fiber Optoelectronics**
  - **Electronic Devices in Optical Fibers**
    - p-i-n junctions, p-n junctions, etc.
  - **Significant Interest from Research Community**
- **Fabrication Processes**
  - **Chemical Vapor Deposition in Capillary Tubes**
  - **Pressure Injection in Capillary Tubes**
  - **Stack and Draw**
- **Scale-able Fabrication Approach**

# Fabrication

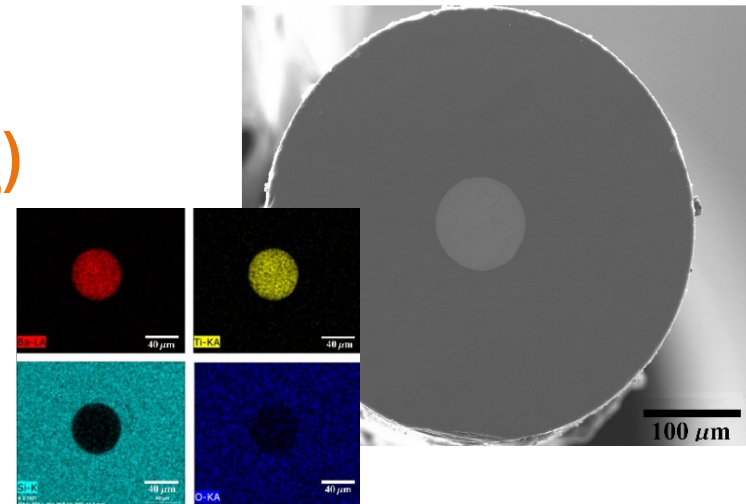
- **Modified Melt-Draw Process**
  - **Preform Fabrication**
  - **Fiber Draw**
- **Custom Drawing System**
  - **Glass Working Lathe**
  - **Maximum Length ~ 1m**
- **Technology Transfer**
  - **Traditional Fiber Optic Draw Tower**
  - **Longer Fiber Lengths**



# “Electronic” Fibers

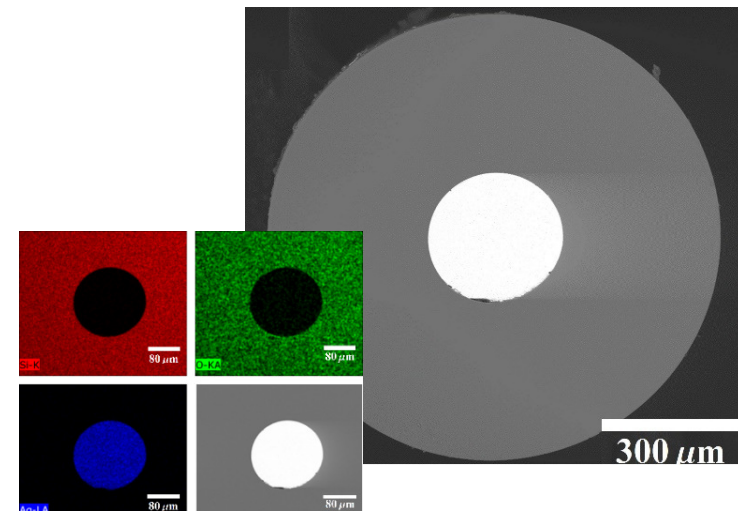
- **Piezoelectric Core**

- Barium Titanate ( $\sim \text{BaTiO}_3$ )
- Energy Harvesting
- Sensors



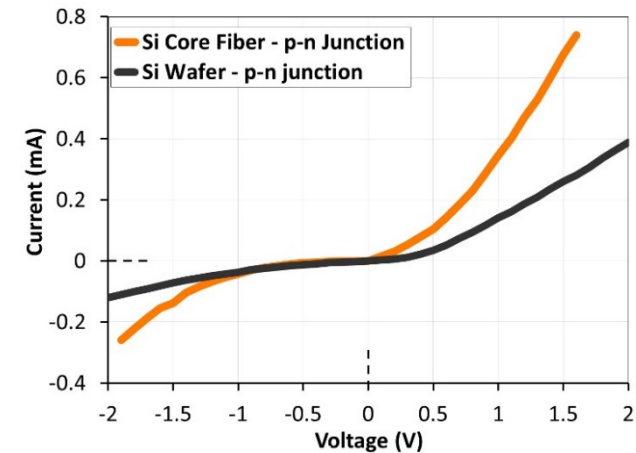
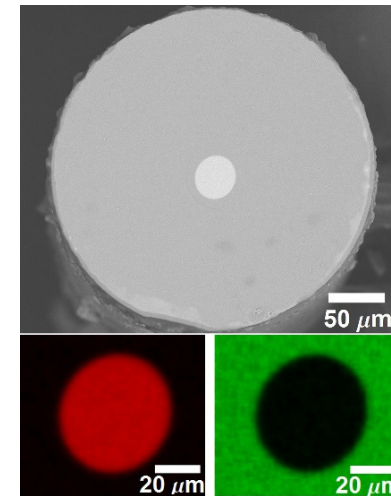
- **Conductor Core**

- Tin (Sn), Copper (Cu)
- Electrical Interconnects
- THz Waveguides



# Semiconductor Fiber

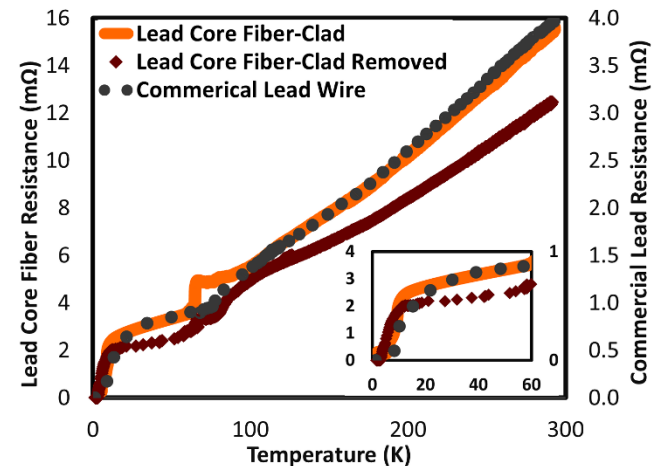
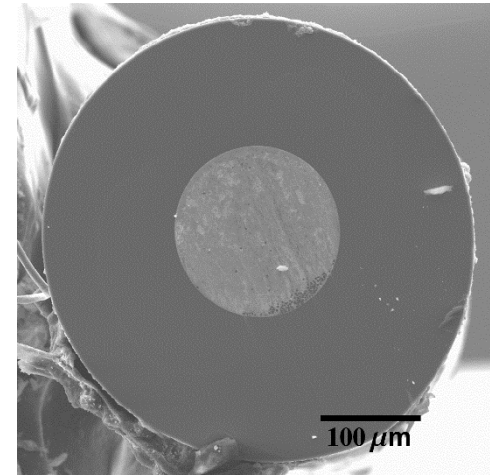
- **Silicon Core Fibers**
  - p-type, n-type, Undoped
  - Fused Silica Cladding
- **p-n Junction**
  - Diffusion of Boron in n-type Fiber
  - Solution Doping Process
- **In-Fiber Electrical Devices**
- **Common Semiconductors**





# Superconducting Fiber TYPE I

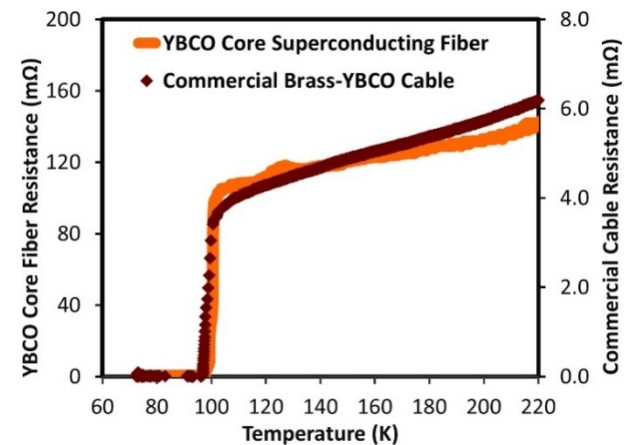
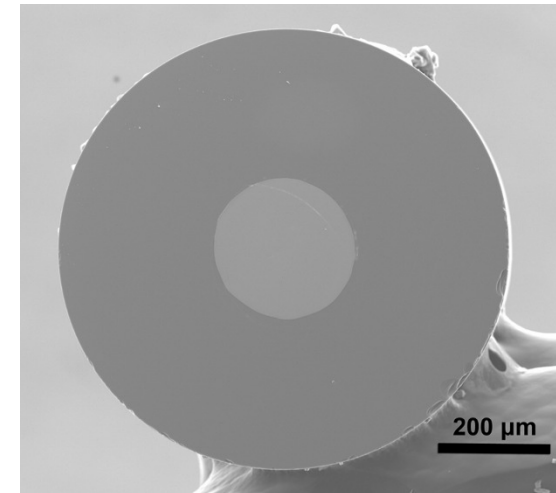
- **Metals**
  - Pb, Sn, In, etc.
  - Liquid Helium Cooling
- **Lead Core Fiber**
  - “Dirty” Superconductor
  - $T_c \sim 7.2K$
- **Relative Ease of Fabrication**



# Superconducting Fiber

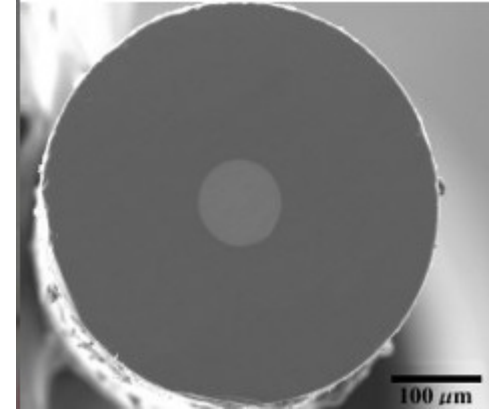
## TYPE II

- Liquid Nitrogen Cooling
- Complex Processing
  - Thin Film Deposition
- Yttrium Barium Copper Oxide
  - Ceramic
  - $T_c \sim 92K$
- Simple Structure



# “Magnetic” Fiber

- **Metglas® Core Fibers**
  - Fe-B-Si Amorphous Metal Alloy
  - High permeability
- **Terfenol-D Core Fibers**
  - $Tb_xDy_{1-x}Fe_2$  ( $x \sim 0.3$ )
  - Extremely High Magnetostriction
- **Fiber Optic Magnetic Sensing**
  - Integration with an FBG, EFPI, etc.



# Moving Forward

- **Increase Breadth of In-Fiber Devices**
- **Transfer Technology to Fiber Optic Draw Tower**
- **Fabricate Long Fiber Lengths ( $\times 10^2$  meters)**
- **Demonstrate Functionality**

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# THANK YOU FOR YOUR TIME

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