UPISC UNIVERSITY OF PITTSBURGH INFRASTRUCTURE SENSING COLLABORATION WORKSHOP

NATIONAL ENERGY TECHNOLOGY LABORATORY

Single crystal fiber growth via LHPG method with focus on material melting properties

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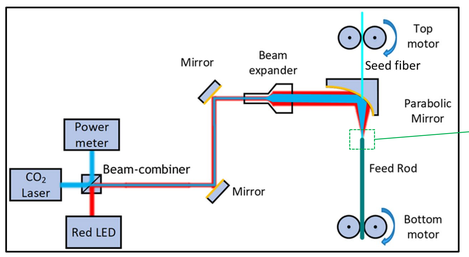
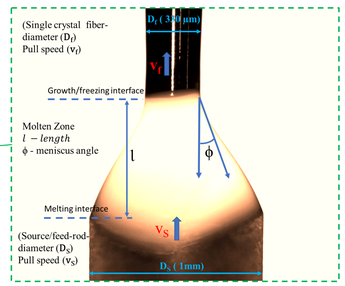
LHPG Setup at Pitt

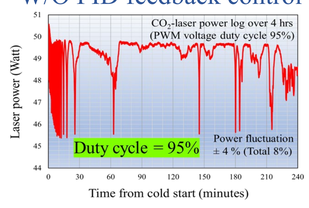


Molten Zone Thermodynamics

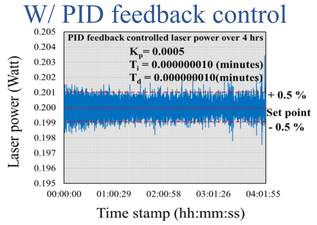


Laser power control (PID feedback loop)

W/O PID feedback control

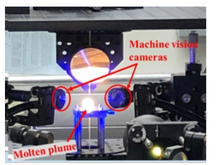


W/ PID feedback control

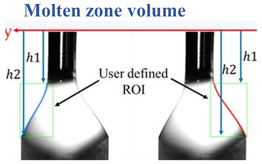


LabVIEW machine vision based in-situ

- ❖Diameter tracking and measurement
- ❖In-situ molten zone contour tracking and volume estimation



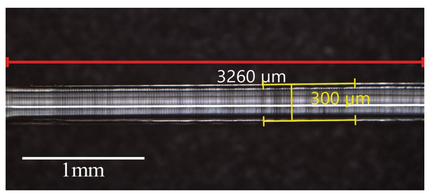
Molten zone volume



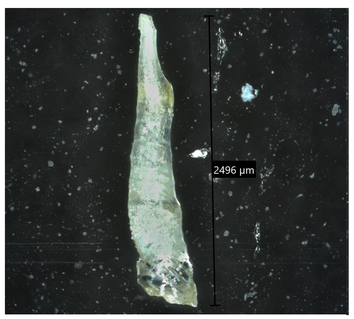
Varied Material Growth

- ❖High temperature ceramic oxides
- ❖Versatility in growing refractory oxides fibers e.g. sapphire, YAG, MO-oxides (YIG/TGG), EO-oxides (LN, BaTiO3)
- ❖Crucible free, high purity, diameter > 100 µm
- ❖Specific focus on magnetic properties for novel magnetic field sensing applications
- ❖Greater understanding of growth characteristics of materials based on melting characteristics; e.g. congruence vs incongruence

Sapphire Fiber Grown at Pitt

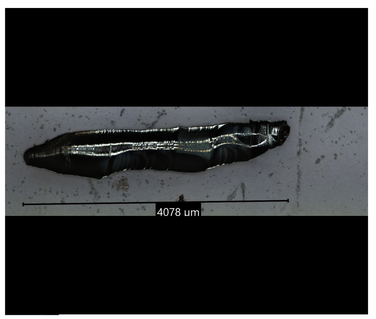


TGG Fiber Grown at Pitt

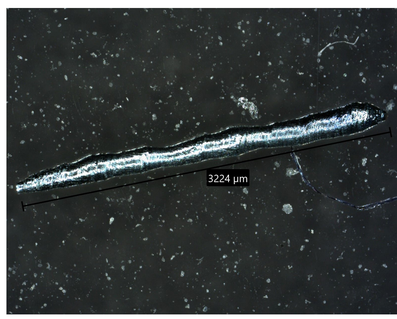


TGG Fiber Grown at Pitt

CoFe Fiber Grown at Pitt



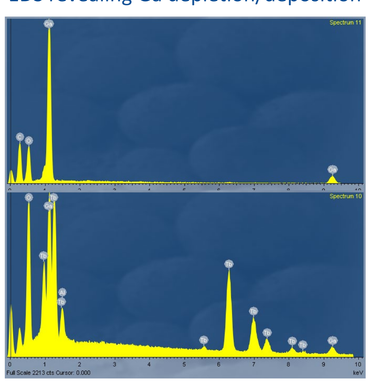
YIG Fiber Grown at Pitt



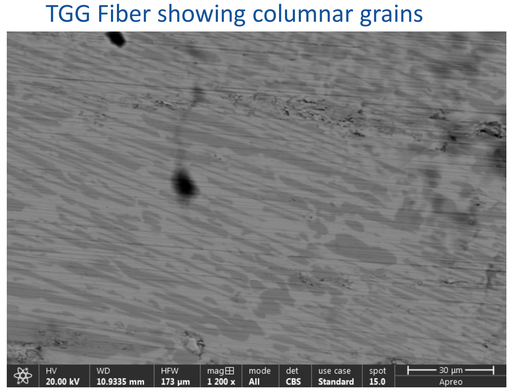
TGG Crystal Structure

- ❖Overcoming the GaO evaporation issue
- ❖Fabrication of different Ga ratios via powder processing methods
- ❖Avoid gallium depleted regions with different crystal structures
- ❖Evolution of elongated grain structures along the direction of growth
- ❖Examined by SCXRD/MicroPXRD to reveal a roughly even mixture of phases

EDS revealing Ga depletion/deposition



TGG Fiber showing columnar grains



XRD of Mixed Phase TGG Sample

Crystal Structures of TGG samples