

Facilities at the University of Idaho

The **Luminescent Materials Lab** of Dr. Bergman at the Department of Physics, University of Idaho, consists of:

1. A three-zone 16 segment programmable tube Lindberg-Blue furnace of operating temperature range RT - 1200°C. Operational in controlled atmosphere.
2. Three 16 segment programmable one-zone tube Lindberg furnaces of operating temperature RT - 1100°C. Operational in controlled atmosphere.
3. MTI tube furnace, GSL1600X, capable of 1600 °C, single zone 30 segment programmable, capable of operating under controlled atmosphere.
4. Ceramics preparation lab:
 - a. Planetary ball mill, Retsch PM 100, capable of 650 RPM, with alumina and agate jars for milling sample material.
 - b. Carver hydraulic press capable of 50,000 lbs ram force, with an approximate upper die size limit of 3.5”.
 - c. Buehler hydraulic press, capable of 10,000 lbs ram force, with an approximate upper die size limit of 2”.
 - d. High precision balance, 0.0001 g resolution.
 - e. Evacuable die for use in hydraulic presses, and supporting vacuum pumps.
 - f. Laurell programmable spin-coating system, capable of 10,000 RPM maximum.
 - g. Hot plates, 500 °C maximum temperature.
 - h. Centrifuge, 10,000 RPM maximum speed.
5. Two fume hoods with flammable and acid storage areas.
6. Custom-built dual gun RF magnetron sputtering system equipped with a special shielding system to prevent damage to flexible substrates from plasma species, capable of base pressure on the order of 10^{-6} Torr, reactive sputtering, substrate temperature control up to 600 °C, and 220 W of sputtering power.
7. Advanced computer network with automatic data backup, searchable database for acquired data and reference information, and environment monitoring. Five computers for student use, two for equipment control, and one server.

The **UV Photoluminescence and Raman Lab** of Dr. Bergman at the Department of Physics, University of Idaho, consists of:

1. A high resolution triple monochromator, T64000 JY-Horiba, micro Raman/PL CCD optical system with a confocal microscope, and hot/cold stages.
2. The optical system is equipped with a monitor for visualization of the sampled area and the laser spot, and a movable microscope sample stage of spatial resolution of 1 μm.
3. UV Lexel laser of excitation line at 244 nm (5.1 eV).
4. UV Kimmon He-Cd laser of excitation line at 325 nm (3.8 eV).
5. A visible laser (Coherent) of lines down to 514 nm (2.4 eV).
6. Absorption system 190-900 nm, Agilent Cary-300, with hot/cold stages.
7. Hot and cold stages, (Janis and Instec), of operating temperature: 4-900 K.
8. Diamond anvil cell (D'anvils), of operating pressure up to ~14 GPa depending on the anvils.
9. A spectrometer dedicated to measuring the ruby pressure gauge.
10. UV and visible microscope objectives, optical filters, and optical fibers.

The **Material Characterization Lab** and the **Center for Electron Microscopy & Microanalysis** at the University of Idaho are available to the PI and equipped with, among others:

1. Zeiss Supra 35 variable-pressure FE-SEM (scanning electron microscope) with 1nm resolution:
 - a. Noran System Six EDS (energy-dispersive X-ray spectroscopy).
 - b. BSE (Backscattered electron) and Cathodoluminescence (CL) imaging.
 - c. Deben Cryostage.
2. JEOL 1200EX II TEM (transmission electron microscope):
 - a. LaB6 gun with 0.5 nm resolution.
 - b. Bright/dark field imaging & electron diffraction.
 - c. SIA CCD camera.
3. X-ray diffraction laboratory.

In collaboration with the Physics Department at the University of Idaho, also available to the PI is an AFM (atomic force microscope). The University of Idaho has a machine shop with experienced staff to fabricate and custom-build sophisticated research-grade equipment

Facilities at Washington State University

In collaboration with Dr. Matt McCluskey at Washington State University, we will have available for our use a reflectance and transmission UV system, Perking Elmer Lambda 800 with N₂ purge, that can probe into the deep UV of 175 nm (~7.1 eV). Also available is a high-resolution Fourier transform infrared (FTIR) spectrometer (spectral resolution 0.013 cm⁻¹ and spectral range from 200 to 10,000 cm⁻¹), a closed-cycle cryostat for operation at temperatures as low as 8 K, various detectors, and a hot stage for temperatures up to 800 K.

In conjunction with the Material Characterization Center in Washington State University, which is six miles apart, also available are XPS, AFM, and other analytical instruments for material characterization.