

**Principal Investigator:**

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**Emergency Information:**

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All other emergencies: 911

**Purpose:**

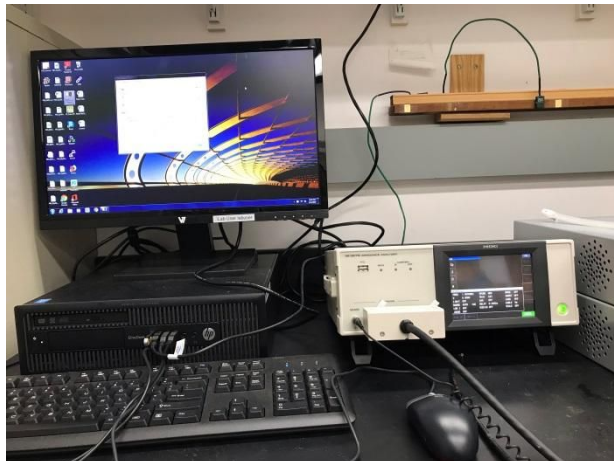
This laboratory is used for dielectric and electrical measurements in a wide temperature range (80-860 K) and general sample preparation. This lab contains some common solvents. Several hand tools are kept in this lab.

*All laboratories and facilities on the Broad Branch Rd. campus are controlled areas. Specific training must be completed and documented before working in this laboratory / facility. All General Laboratory Safety Rules apply in this space.*

**Instruments Standard Operational Protocol**

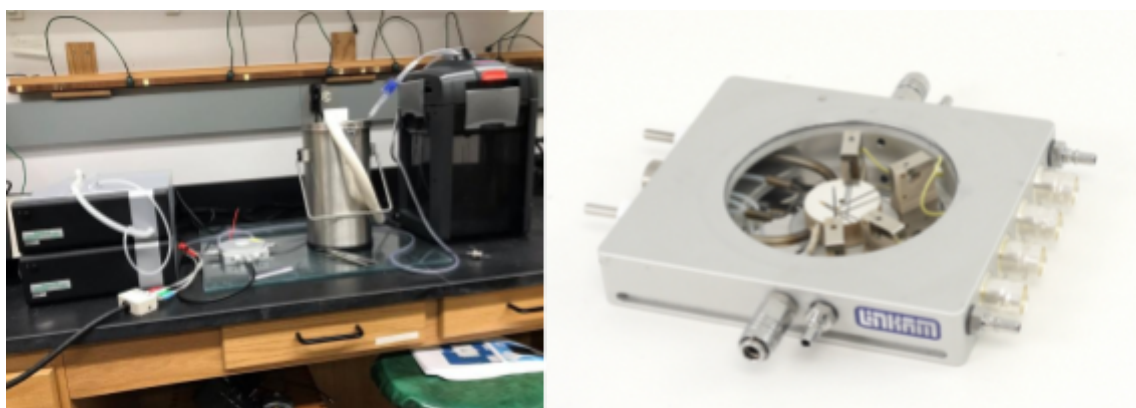
Users of this Laboratory must complete the instrument-specific training, in order to use these facilities.

This laboratory has one impedance analyzer for the purpose of dielectric and electrical measurements: HIOKI IM3570 Impedance/LCR meter.



**Fig 1. Impedance analyzer set up at GL.**

This laboratory has one probe stage with four positional gold tipped probes for the purpose of electrical measurements in a temperature range of 80 to 860 K up to 150 K/min heating with a temperature stability of  $< 0.1$  K: LINKAM HFS600E-PB4 stage. This stage can be connected to other measurements systems through connectors. This system is also compatible for light microscopy and spectroscopy measurements including Raman and X-Ray (Fig. 2).



**Fig. 2. Probe Stage with temperature controllers systems (left), Probe stage with four probes (right) at GL**

This laboratory has one high voltage power supply system to pole the ferroelectric and multiferroic ceramic samples: FLUKE 415B. This power supply system is capable of providing 0 to 3100 volts dc and 0 to 30 milliamperes current.



**Fig. 3. High Voltage power supply system at GL**

This laboratory has two hydrothermal autoclave reactors to prepare samples: COLUMBIA INTERNATIONAL.



Fig.4. Hydrothermal autoclave (a) white teflon lined (left) (b) black teflon lined reactors at GL

This laboratory has also hot plate and oven for general sample preparation.

#### Instrument safety instructions:

1. *All users must obtain instrument-specific training in order to operate equipment lab.* There are manuals and operation procedures for each instrument.
2. Before you start your experiment, you must spend time to read them for your safety. *All users must first become "authorized users" to be able to operate the instrument independently.*
3. Always use the instrument log book and keep detailed notes.

#### After hours Restrictions:

1. The use of instruments after hours is not restricted. All users must consult with PI prior to working alone / after hours in the laboratory. The repair of instruments after hours is also required the permission of PI.

#### High Voltage Power Supply System

1. Please read the manual carefully before using this system.
2. This power supply can produce lethal voltage. Always set the HIGH VOLTAGE switch to STDBY / RESET and wait until the output voltage has decayed to zero before connecting or disconnecting the load.
3. Connect the load circuit securely to the output connector. Check the external circuit for conflicts in grounding before applying power to the load.
4. Rapidly decreasing the setting of the OUTPUT VOLTAGE dials with the high voltage on may

damage the sampling string resistors. When dialing down the OUTPUT VOLTAGE, pause approximately ½ second in each switch position.

5. It is recommended to operate this machine with presence of some other person.

### Hydrothermal Autoclave Reactors:

1. Please read the manual carefully before using this system.
2. The maximum working temperature of white teflon lined reactor is 200 °C and black teflon lined reactor is 230 °C with a maximum heating rate of 20 °C/min. Please don't cross the limit.
3. Do not operate the autoclave without water.
4. Do not put any extra weight on the autoclave.
5. Do not attempt to open the autoclave during a cycle.
6. Wait until the materials are cooled prior to removing from the autoclave.
7. Close the autoclave caps properly, never try to open it by force without first loosening of primary cap with the help of tightening rod.
8. Ensure that the pressure gauge is operating correctly.
9. Make sure the both stainless steel gaskets are in a good shape & condition. Do not lubricate the Gasket.
10. Do not place flammable liquids or chemicals which could become unstable at elevated temperatures.
11. A risk of explosion or implosion exists when using autoclaves if not treated properly. In addition to the dangerous destructive force of such equipment failure, these events are also likely to result in the release of hazardous materials. Accordingly, personnel who operate the autoclave must be trained to understand proper packaging, loading, labelling, as well as operation and emergency procedures.

### Glassware Cleaning and Disposal

1. Cleaning of glassware:

All re-usable glassware, including beakers, flasks, and funnels should be emptied of chemicals using proper safety procedures and then rinsed, washed and ashed using standard protocols. Cleaned glassware should be covered with aluminium foil and stored in glass front cabinets.

2. Disposable glassware:

All used disposable glassware, including vials and pipettes should be emptied of chemicals and discarded into an approved closer container for glassware disposal.

### Additional safety information

- Properly label, store and dispose of all chemicals and waste.
- Study MSDS sheets on all chemicals that you will work with. Chemical safety datasheets are available at <https://www.msdonline.com/>. Chemicals, aside from common solvents are not to be stored in R123.
- Personal protection equipment including gloves, goggles and lab coats should be used when necessary. All of these items are available in the lab.
- Fire extinguishers are located near the laboratory door and in the hallway.
- The emergency eyewash is located at the sink. The emergency chemical shower is located near

the door of the laboratory.

- Keep laboratory doors locked during off hours unless you are actively using the facilities.
- Any breach of operational and safety protocols may lead to loss of laboratory privileges.

#### Laboratory User

*I agree that I have thoroughly read and understood this laboratory safety document. I have access to this safety information at all times when I am working. I have been trained to be able to identify the hazards to which I may be exposed and to follow the work practices and procedures discussed in this document. I certify that I will conduct my research work safely and that I will be responsible for following stated safety policies.*

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User Name (Print)

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User Signature

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Date

#### Principal Investigator

*I certify that the information presented in this safety document is accurate and complete. I agree to comply with all safety procedures and to fully train and supervise all researchers under my direction.*

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PI Signature

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Date