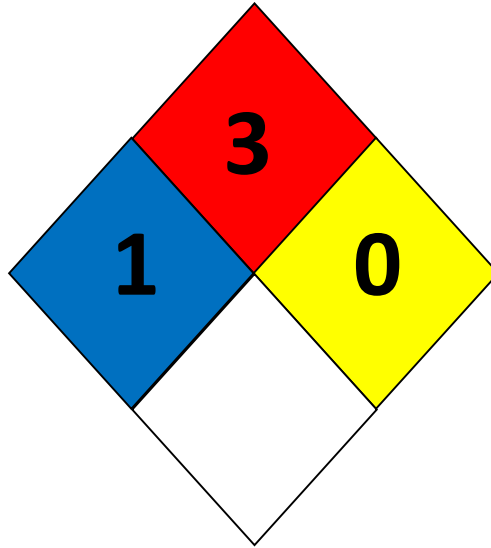


WVU Shared Research Facilities

# XRD Lab – White Hall Chemical Hygiene Plan

402 - 402A – 402A1 White Hall



Emergency Contact:

**HARLEY HART**





Office: 409 White Hall

G75D Engineering Sciences Building

Cell Phone: (412) 443-1514

Kolin S. Brown; Harley Hart; Weiqiang Ding  
8/29/2013

**SECTION 1.1: NFPA CHEMICAL HAZARD LABEL**

					
RATING NUMBER	HEALTH HAZARD	FLAMMABILITY HAZARD	INSTABILITY HAZARD	RATING SYMBOL	SPECIAL HAZARD
4	Can be lethal	Will vaporize and readily burn at normal temperatures	May explode at normal temperatures and pressures	ALK	Alkaline
3	Can cause serious or permanent injury	Can be ignited under almost all ambient temperatures	May explode at high temperature or shock	ACID	Acidic
2	Can cause temporary incapacitation or residual injury	Must be heated or high ambient temperature to burn	Violent chemical change at high temperatures or pressures	COR	Corrosive
1	Can cause significant irritation	Must be preheated before ignition can occur	Normally stable. High temperatures make unstable	OX	Oxidizing
0	No hazard	Will not burn	Stable		Radioactive
					Reacts violently or explosively with water
					Reacts violently or explosively with water and oxidizing

This chart for reference only - For complete specifications consult the NFPA 704 Standard  
NFPA-Chart\_1 www.ComplianceSigns.com

Figure 1: NFPA Explanation Chart

**NFPA Rating** - The National Fire Protection Association (NFPA) has developed a standard system (ANSI/NFPA 704) for indicating the health, flammability, and reactivity hazards of chemicals. In addition, a special precaution symbol may be used where necessary.

This system of identifying hazards associated with various materials was developed primarily for fire protection and emergency personnel but can be useful to anyone who needs to handle potentially hazardous material. As stated in NFPA 704, "This standard provides a simple system of readily recognizable and easily understood markings, which will give at a glance a general idea of the inherent hazards of any material and the order of severity of these hazards as they relate to fire prevention, exposure, and control."

**General Rating Summary:**

**Health (Blue)**

- 0- Hazard no greater than ordinary material
- 1- May cause irritation; minimal residual injury
- 2- Intense or prolonged exposure may cause incapacitation: residual injury may occur if not treated
- 3- Exposure could cause serious injury even if treated
- 4- Exposure may cause death

**Flammability (Red)**

- 0- Will not burn
- 1- Must be preheated for ignition, flashpoint above 93°C (200°F)
- 2- Must be moderately heated for ignition flashpoint above 83°C (100°F)
- 3- Ignition may occur under most ambient conditions, flashpoint below 83°C (100°F)
- 4- Extremely flammable and will readily disperse through air under standard conditions, flashpoint below 83°C (100°F)

**Instability (Yellow)**

- 0- Stable
- 1- May become unstable at elevated temperatures and pressure, may be mildly water reactive
- 2- Unstable; may undergo violent decomposition, but will not detonate. May form explosive mixtures with water
- 3- Detonates with strong ignition source
- 4- Readily detonates

**Special Symbols (White)**

**OX-** oxidizer

**W-** Water reactive, use no water

**SECTION 1.2: EMERGENCY CONTACTS**

In case of **FIRE**, **INJURY**, or **EMERGENCY ASSISTANCE**, contact in the following order:

**9-911** from any campus phone

or

**Campus Security**

Phone: (304) 293-2677 (293-COPS)

Then Call

**Harley Hart**, SRF Manager

Cell Phone: **(412) 443-1514**

Room: **G75D ESB / 409 White Hall**

or

**Weiqiang Ding**, SRF Manager

Cell Phone: **(304) 685-1938**

Office Phone: **(304) 293-9683**

Room: **G75D ESB / 409 White Hall**

If no one responds to any numbers above, then contact:

**Phillip Tucker**, Lab Instrumentation Specialist for Department of Physics, Eberly College of Arts and Sciences  
Cell Phone: **(304) 292-1160**  
Office Phone: **(304) 293-3422 x69956**  
Room: **G12 White Hall**

**Dr. Earl Scime**, Chairperson for Department of Physics, Eberly College of Arts Sciences  
Cell Phone: **(304) 282-4473**  
Office Phone: **(304) 293-5125**  
Room: **111D White Hall**

For Radiation related **EMERGENCIES** contact:

**Radiation Safety Department**  
Office Phone: **(304) 293-3413**  
24 Hour On Call Pager: **(304) 987-1586**

For non-emergency assistance please contact:

**Weiqiang Ding**, SRF Manager  
Cell Phone: **(304) 685-1938**  
Office Phone: **(304) 293-9683**  
Room: **G75D ESB / 409 White Hall**  
or  
**Harley Hart**, SRF Manager  
Cell Phone: **(412) 443-1514**  
Room: **G75D ESB / 409 White Hall**

## SECTION 1.3: EMERGENCY EVACUATION PROCEDURES

### XRD White Hall Lab Evacuation Plan

**In case of Fire all users should evacuate the entire lab immediately!**

- Use the shortest, unobstructed path to the exterior of the building.
- Only if it is safe to do so, users should turn off the XG controller and move the breaker switch behind the tool to the off position prior to evacuating.

**In case of Chemical Spill all users should evacuate the entire lab immediately!**

- Only if it is safe to do so, users should attempt to contain the spill using the spill kit located in 402 by the entrance door. Then the user should notify MCF Staff immediately!

**XRD Lab Evacuation Plan**

402 White Hall  
XRD Control Lab

You are here!

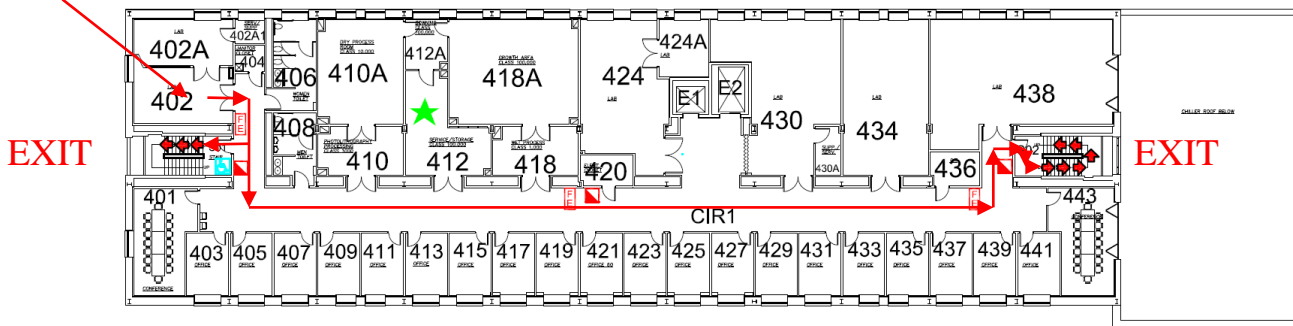


Figure 2: White Hall 402 Evacuation Plan

**XRD Lab Evacuation Plan**

402A White Hall  
XRD Equipment Lab and Sample Prep Space

You are here!

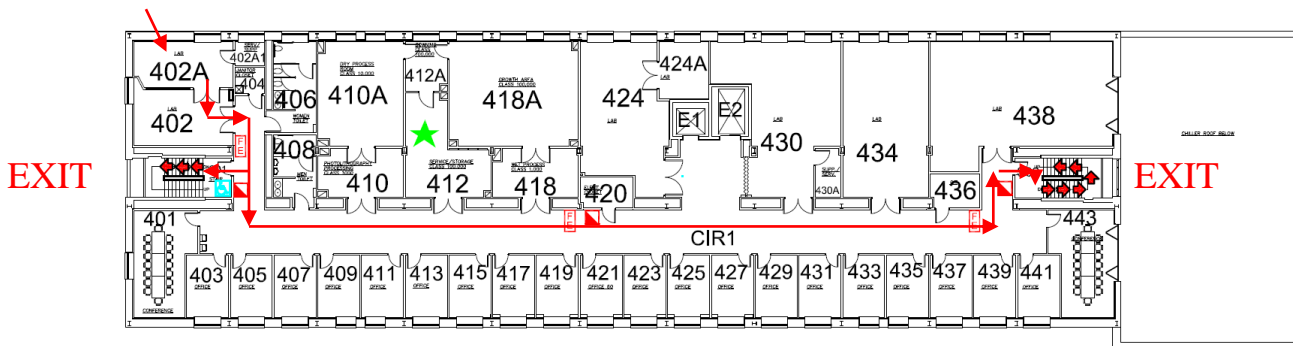


Figure 3: White Hall 402A Evacuation Plan

## XRD Lab Evacuation Plan

402A1 White Hall  
Water Chiller Room

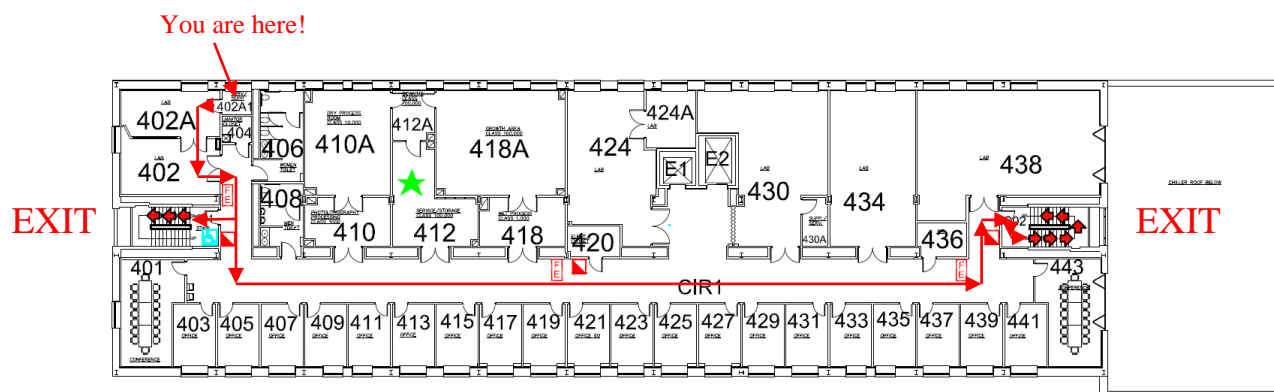


Figure 4: White Hall 402A1 Evacuation Plan

### SECTION 1.4: EMERGENCY SHUTDOWN PROCEDURES

If a dangerous situation is evident (smoke, fire, sparks, etc.), ONLY if it is safe to do so, should a user attempt to shut down a system. The user should then notify all other persons within the XRD lab to evacuate immediately. After evacuation, a user should contact proper emergency personnel from a safe place.

If the tool is not acting as expected then the user should attempt to put the tool in its default mode; do not leave the tool running in an abnormal state! If the tool cannot be placed in its default mode, the user should stay by the tool and contact one of the WVU Shared Facilities staff members. If it becomes necessary to leave the tool then the user should leave a large, legible note on the tool stating that the tool is down. The user should also report this through the FOM by entering the details of the issues in the PROBLEM REPORT section of the FOM before logging out.

Listed below are the procedures to place each tool into a safe default mode, or to shut down each tool. Detailed shutdown procedures may be found on the cover of each tool logbook or in the Standard Operating Procedures found in Appendix C.

#### RIGAKU XRD-WH:

Emergency shut-down:

- Turn OFF the system power by pressing the RED OFF button on the XG Controller
- Toggle the roughing pump and turbo pump switch to the OFF position.
- Move the wall breaker switch of the XRD located behind the tool to the OFF position.

- **Move the wall breaker switch of the Haskris water chiller in room 402B to the OFF position.**
- **Turn OFF the detectors**

To place in default mode:

- **Turn OFF the system power by pressing the RED OFF button on the XG Controller.**
- **Turn OFF the detectors**

## SECTION 1.5: RADIATION EXPOSURE RESPONSE

The Rigaku Ru-300 XRD uses a high-intensity x-ray beam for sample characterization. If any part of the body, most likely the hand, is exposed or possibly exposed then permanent damage to body can occur. If this occurs, contact the following:

**Radiation Safety Department**

Office Phone: **(304) 293-3413**

24 Hour On Call Pager: **(304) 987-1586**

and,

**Weiqiang Ding**, SRF Manager

Cell Phone: **(304) 685-1938**

Office Phone: **(304) 293-9683**

Room: **G75D ESB / 409 White Hall**

or

**Harley Hart**, SRF Manager

Cell Phone: **(412) 443-1514**

Room: **G75D ESB / 409 White Hall**

**Then, arrange for a medical examination. Be sure to inform the physician that exposure to low-energy x-rays may have occurred!**

## SECTION 1.6: EMERGENCY RESPONSE EQUIPMENT

**First Aid kits** are located in lab **402** of **WHITE HALL** next to the entrance door.

The nearest **AED** (Emergency Defibrillator) is located on the first floor of the Wise Library building next to White Hall to the right of the elevators.

**LAB DOES NOT HAVE EYEWASH STATION!**

The **Chemical Hygiene Plan** and **MSDS** are located in room **402** of **WHITE HALL** on the entry door.

## SECTION 2: LAB OVERVIEW

The WVU Shared Research Facilities XRD Lab of the MCF is a specialized laboratory environment for characterization of epitaxial thin films and powder through x-ray diffraction. This lab consists of 275 square feet of space and is part of a three room lab suite.

As part of the WVU Shared Research Facilities, the XRD Lab provides student and postdoctoral researchers the opportunity to learn and use the Rigaku Ru-300 X-ray Diffractometer for sample characterization. The facility is open to all researchers, including researchers at government laboratories and industries.

### SECTION 2.1: FACILITY DESCRIPTION

The WVU SRF XRD Lab of the MCF facility is part of a suite of three rooms:

- 402 Control Lab: Contains the computers which operate the XRD and is part of ECAS Department of Physics Sample prep space used for wet chemical processing.
- 402A XRD Lab: Contains the Rigaku Ru-300 XRD and is built to serve as a radiation enclosure. This room also contains sample prep space and storage space for the Rigaku RU-300.
- 402A1 XRD Chiller Space: Contains the water chiller for the XRD and is the connected to the White Hall processed chilled water system.

**WARNING:** WVU Shared Research Facilities MCF users are NOT authorized to use the chemical hoods in 402 unless granted permission in email from the Department of Physics. Any questions, concerning this should be directed to the WVUSRF MCF Staff.

### SECTION 2.2: LABORATORY ACCESS

Access to the WVU Shared Research Facilities is controlled through the WVU ONITY Lock system. The three XRD Lab locks of White Hall are located on the doors to 402, 402A, 402A1.

WVU Shared Research Facilities and ECAS have identified the XRD Lab locks, 402, 402A, and 402A1 as restricted locks. Access to these locks is only given to lock shop personnel, campus security, emergency services, appropriate ECAS Administration, Shared Research Facilities staff, and cleanroom users. Please contact Harley Hart at [harley.hart@mail.wvu.edu](mailto:harley.hart@mail.wvu.edu) for questions related to these restrictions.

The following persons are the official operators of these locks:

Kolin S. Brown  
Lisa Sharpe  
Harley Hart  
Chris Tarabrella



In addition the WVU Lock Shop and WVU Card Services also have capabilities to give students, staff and faculty access in these locks.

MCF users are only given access to the XRD Lab during normal working hours after they have completed all required safety trainings, have a signed user agreement on file with the SRF MCF Manager, and have completed training on the XRD.

The normal working hours of the XRD Lab - WH are 8AM-5PM, Monday–Friday and the after-hours are 5PM-8AM, Monday-Friday; weekends and holidays are all hours.

MCF users reserve the time on the instruments via online reservation system (FOM). <http://fom.wvu.edu/fom>

### SECTION 2.2.1: REQUIRED SAFETY TRAINING

All MCF users must complete the following the following safety training to receive access to the facility during normal working hours.

- WVU SRF General Lab Safety Training
- WVU SRF Chemical Safety Training
- **WVU Radiation Safety Training – In Process**
- Read and sign the WVUSRF MCF XRD Lab Chemical Hygiene Plan sign-in sheet in Appendix B

Copies of the WVU SRF safety presentation slides and CHP are located on the Shared Research Facilities website:

<http://sharedresearchfacilities.wvu.edu/safety/srfSafetyMain.html>

### SECTION 2.2.2: REQUIRED SYSTEM TRAINING

All MCF users must complete the following the following safety training to receive access to the facility during normal working hours.

- Users must take general lab safety training and chemical safety training before working in the lab.
- Copies of the safety presentation slides are located on the Shared Research Facilities website: <http://sharedresearchfacilities.wvu.edu/safety/srfSafetyMain.html>
- Users will take instrument operation trainings and then be observed using the tools before granted day-time access to the lab.
- Experienced users will receive additional trainings and be evaluated before granted unlimited access to the lab.

### SECTION 2.2.3: USER AGREEMENTS

All MCF users must have a user agreement on file with the WVU SRF MCF Manager. User agreements must be signed by the user, the user's advisor and the user's department chair, when appropriate.

Copies of the User Agreements are located on the Shared Research Facilities website:  
<http://sharedresearchfacilities.wvu.edu/forms/srfForms.html>

### SECTION 2.2.4: RADIATION BADGE

All MCF users must have submitted a completed Radiation Badge Application form (see the following website: <http://www.hsc.wvu.edu/rsafety/Forms> before training). After the MCF staff receives the application, it will be signed and submitted to the WVU Radiation Safety Department. Once the Radiation Badge has been delivered to the MCF staff, training on the tool will be scheduled.



*Figure 5: Image of OLSD and Ring Badge to be worn while operating XRD*



*Figure 6: Image of Ring Badge to be worn while conducting maintenance on the XRD*

#### Individual Monitoring Device:

All individuals who operate the Rigaku Ru-300 XRD are required to wear at all times a Luxel Optically Stimulated Luminescent Whole Body Dosimeter (OLSD). This is to be worn on the chest or collar depending on individual's height – see Radiation Badge Application instructions on the WVU Shared Research Facilities website. This device is used to record user's radiation exposure while operating the XRD. Radiation badges will be changed quarterly.

#### Fetal Monitoring Device

A woman who is planning or may be pregnant has the option to declare the pregnancy and take advantage of lower federal limits to the embryo/fetus. Be advised that notification of the

pregnancy is the responsibility of the user. The user should notify her direct supervisor and the MFCF manager. The user must also submit a “Declared Pregnancy Form” (see the following website: <http://www.hsc.wvu.edu/rsafety/Forms> ) directly to the MFCF staff who will send the document to the WVU Radiation Safety Office (RSO). The RSO will then assign a monthly monitoring device to the user which should be worn on the waist to monitor the embryo/fetal dose rate as well their own monitoring device. This document remains active until written documentation is submitted to the RSO stating otherwise.

### Exposure Reports

Copies of Individual Exposure Reports are kept on file in the WVUSRF MFCF staff office in White Hall room 409. This information can also be obtained by contacting the WVU Radiation Safety Office.

Table 1 is a listing of NRC Occupational Dose Limits:



The image shows a slide titled "NRC Occupational Dose Limits" with a table of limits. The table lists various dose limits in mrem/yr for different parts of the body and for the general public. A note at the bottom states "Note: 1,000 mrem = 1 rem".

NRC Occupational Dose Limits	
Whole Body (TEDE)	5,000 mrem/yr
Any Organ (TODE)	50,000 mrem/yr
Skin (SDE)	50,000 mrem/yr
Extremity (SDE)	50,000 mrem/yr
Lens of Eye (LDE)	15,000 mrem/yr
Embryo/Fetus of DPW	500 mrem/yr
Member of the Public	100 mrem/yr

Note: 1,000 mrem = 1 rem

*Table 1: NRC Occupational Dose Limits*

### Dosimeter Protocols:

- MUST be worn at all times when working the XRD
- ONE BADGE per equipment. If a user is to be using multiple radiation generating devices, then a separate radiation badge needs to be issues for each unit.
- NEVER wear another individual’s monitoring device

Additional information is found in Appendix B of the CHP or at <http://www.hsc.wvu.edu/rsafety/Dosimetry>

## SECTION 2.2.5: DRESS CODE REQUIREMENTS

The following dress code is required for all users entering the XRD Lab:

1. No shorts, legs must be fully covered
2. No sandals or open toed shoes, feet must be fully covered
3. Watches and jewelry should be removed from person while operating the XRD
4. Radiation Badge must be attached to person.

Users entering the XRD Lab 402A must be wearing their assigned Radiation Badge while the XRD generator is energized. Radiation Badges are to be stored in the container outside of the 402A entrance when not in use. These badges are changed out quarterly according to the WVU Radiation Safety Guidelines.

If you would like to view your quarterly radiation exposure results, contact a WVU SRF MCF staff manager as this information is kept in the Office of 409 White Hall along with Radiation Badge applications.

#### SECTION 2.2.6: AFTER HOUR ACCESS

After hour access to the MCF XRD Lab is given upon request by the WVU Shared Research Facilities MCF Manager. The MCF manager will use his own discretion to grant access when a user has demonstrated he or she can work alone safely and handle an emergency.

#### SECTION 2.2.7: TEMPORARY USER SUPERVISION

Temporary users in the MCF XRD Lab must be accompanied by a trained XRD user or staff member at all times and must follow all safety protocols while present in the lab. Temporary users may include summer research participants, visitors or class participants.

**Warning: Temporary users or users who have not been fully trained are NOT permitted to enter room 402A if the XRD system is energized unless the user has been trained on the equipment and has a radiation badge assigned to him/her for the XRD.**

## SECTION 3: CHEMICAL SAFETY

The following chemicals are always available in the XRD Lab:

- Isopropanol
- Vacuum Grease

These lists represent the standard process chemicals used inside the XRD Lab by WVUSRF users. A current chemical inventory may be found in Appendix B. This inventory is updated each semester. The XRD lab is a multiuser facility that supports a wide variety of research projects.

For a list of other chemicals for non-WVUSRF users stored in the 402 Lab White Hall Suite, see the Physics Department MSDS book located in lab 414 of White Hall.

In addition to process chemicals, hydrocarbon based oils and mineral oil are stored and used by the XRD Lab equipment.

### SECTION 3.1: CHEMICAL STORAGE

WVUSRF users are NOT authorized to store chemicals in labs 402, 402A, or 402A1 of White Hall. If a user needs to store chemicals in 402, then the user must contact the Chemical Hygiene Officer and Physics Lab Manager:

**Phillip Tucker**, Lab Instrumentation Specialist for Department of Physics, Eberly College of Arts and Sciences  
Cell Phone: **(304) 292-1160**  
Office Phone: **(304) 293-3422 x69956**

### SECTION 3.2: AUTHORIZING CHEMICAL USAGE

The WVU Shared Research Facilities MCF staff only purchases chemicals that are for general use. Often, research projects require the use of chemicals that are specific to a project. Any user, who wishes to bring a new chemical into the XRD – WH Lab, must first obtain permission from the Department of Physics CHO – Phillip Tucker and MCF staff before bringing a new chemical into the lab. The user must submit a signed material tracking form and a material safety data sheet(s) (MSDS) for each chemical container to the MCF manager for approval. A copy of this form can be found on the shared research facilities website (<http://sharedresearchfacilities.wvu.edu/forms/srfForms.html>). This form identifies the chemical, proper storage and proper disposal methods. Material tracking forms are kept in a binder in the SRF MCF manager's office. The MSDS are added to the MSDS file kept in 402 of White Hall.

All containers must be brought to a SRF staff member to receive an approved chemical label, which is signed and dated by the SRF staff member. The chemical container must be appropriate for the chemical and it must be labeled appropriately with the full chemical name to receive an approved chemical label. Only containers with approved chemical labels may be taken into the XRD Lab.

A chemical must be approved before being brought or stored into the XRD Lab, even if the chemical is only going to be used one time.

### SECTION 3.3: CHEMICAL HANDLING

Wet chemical processing or any work with open chemical vessels must be performed in a chemical hood. The XRD lab has two chemical hoods, and each is designated for a specific type of process. WVUSRF users are not authorized to use the chemical hoods in 402 without written permission from Physics Department. For access to the chemical hoods in 402 users must contact the Department of Physics and read the appropriate Chemical Hygiene Plan.

A rinse bottle with isopropanol can be found on the sample prep table in 402A. This is used for substrate/sample cleaning only. Safety gloves and glasses are required when using this rinse bottle.

**WARNING:** Users should use designated hoods for specific chemical processing. Using acids in the solvent hood or solvents in the acid hood may result in an explosion.

### SECTION 3.4: ACCIDENTAL CHEMICAL EXPOSURE

Users are required to wear appropriate personal protective equipment (PPE) for their safety, if at any piece of PPE becomes damaged or torn it should be replaced immediately. If a user has been exposed to a chemical, the following procedures should be followed immediately.

For eye exposure:

1. Remove all contaminated clothing and gloves.
2. Initiate water flow at eyewash station by either pressing on the pedal or the hand lever.
3. Hold eyes open with fingers and lower face into eyewash bowl, so that water is rinsing the eyes.
4. Keep eyes open and rotate.
5. Flush eyes for a total of 15 minutes.
6. Seek emergency medical attention.

For exposure to any part of the body:

**WARNING:** Do not wipe off the chemical; you will only increase area of contact! Increasing area of contact will increase absorption through the skin and may result in faster or more severe reaction or poisoning.

1. Remove all contaminated clothing and gloves.
2. Initiate water flow at safety show by pulling down ring.
3. Flush contaminated area for a total of 15 minutes.
4. Seek emergency medical attention

In case of **MEDICAL EMERGENCY** contact:

**9-911 from any campus phone**

or

**Campus Security**

Phone: **(304)293-2677 (293-COPS)**

If going to the hospital for medical assistance, make sure you:

- Take a copy of the MSDS with you
- Inform medical personnel if you have been working with or have been exposed to HF

### **SECTION 3.5: CHEMICAL SPILL RESPONSE**

If at any time a user is unsure of how to clean up a spill or is uncomfortable in trying to clean up the spill they should immediately evacuate the area and seek assistance. Users should attempt to only contain the spill and then seek assistance from the SRF MFCF staff. Personal protective equipment should be worn at all times.

A spill kit is kept in 402 by then entrance door. Users should only attempt to contain the spill if it is less than one gallon.

**If a chemical spill occurs, contain the spill by doing the following:**

1. Open the spill kit by pressing the red lever with the thumb and rotating the lid counter clockwise.
2. Put on the gloves inside the spill kit.
3. Remove a pink absorbent pad and place over the spill area. Use as many pads as necessary to contain the spill.
4. Seek SRF MFCF staff assistance.
5. With staff assistance, place all pads in the garbage bag.
6. Remove any remaining contents from the spill kit and place the garbage bag inside the pail.

7. Close the spill kit lid.
8. Fill out the USED Spill Kit label and attach to outside of the kit.
9. The cleanroom staff will contact EH&S for pickup.

**NOTE: ALWAYS TRY TO ATTEMPT TO KEEP SPILL FROM ENTERING DRAIN SYSTEM.**

In case of an **ACUTELY HAZARDOUS SPILL** contact in the following order:

**Environmental Health & Safety**

Phone: **(304) 293-3792**

Then Call,

**Kolin Brown**, SRF Manager

Cell Phone: **(304) 685-1938**

Office Phone: **(304) 293-9683**

Room: **409 White Hall / G75D ESB**

or

**Harley Hart**, SRF Manager

Cell Phone: **(412) 443-1514**

Room: **409 White Hall / G75D ESB**

If no one responds to any numbers above, then contact:

**Phillip Tucker**, Lab Instrumentation Specialist for Department of Physics, Eberly College of Arts and Sciences

Cell Phone: **(304) 292-1160**

Office Phone: **(304) 293-3422 x69956**

Room: **G12 White Hall**

**Dr. Earl Scime** Chairperson for Department of Physics, Eberly College of Arts Sciences

Cell Phone: **(304) 282-4473**

Office Phone: **(304) 293-5125**

Room: **111D White Hall**

## SECTION 3.6: CHEMICAL DISPOSAL

Chemical waste jars are not to be created or stored in 402A or 402A1.

### SECTION 3.6.1: HAZARDOUS WASTE DISPOSAL

Chemical waste jars are not to be created or stored in 402A or 402A1.



### SECTION 3.6.2: CONTAMINATED MATERIAL HAZARDOUS WASTE DISPOSAL

Any wipe that has been contaminated with IPA must be disposed of as hazardous waste. A “Used Wipes” waste container with lid is kept on the sample prep table of 402A. The contents of these containers are collected weekly on Friday by the SRF MCF staff and taken to room 414 and placed in the sealed drum for Used Wipe collection. EHS retrieves these wipes for disposal on Friday of each week.

### SECTION 3.6.3: USED OIL DISPOSAL

The Rigaku RU-300 XRD has two pumps which use hydrocarbon oil:

- Roughing Pump: BOC Edwards Ultra Grade 19
- Turbo Pump: TL011 Pump Oil

All used oil is captured and stored in an appropriately chosen waste jar which is properly labeled with the words USED OIL. A hazardous chemical disposal form is filled out and submitted to EH&S for pickup and it is taken to 414 for pickup. A copy of the hazardous chemical disposal form can be found on the WVU EH&S website, <http://ehs.wvu.edu/forms>.

### SECTION 3.6.9: WATER USAGE

The heat exchanger water reservoirs of the XRD should only be filled with distilled water. The distilled water bottles can be found on the floor window sill next to the XRD chiller.

## **SECTION 4: GAS SAFETY**

The XRD does not use any gases for operation.

For a full list of gases with specific information on each gas and location, please contact the Physics Department Chemical Hygiene Plan for Room 402.

### **SECTION 4.1: TOXIC GASES**

The XRD does not use toxic gases for operation.

### **SECTION 4.2: FLAMMABLE GASES**

The XRD does not use flammable gases for operation.

## SECTION 5: LABORATORY HAZARDS

Users should be aware of additional hazards when working in the XRD Lab, these are:

- Sharps and broken glass
- High voltages

### SECTION 5.1: SHARPS AND BROKEN GLASS DISPOSAL

A broken glass disposal box is kept outside of the entrance to 402A. This box is for the disposing of broken glass or substrates. SRF staff members inspect this box monthly. When full, the box is sealed and disposed with the laboratory trash.

A small sharps disposal box is kept on the 402A sample prep table. This box is primarily for the disposal of razor blades, though any sharp may be disposed of here. This box is NOT for the disposing of broken glass or substrates. SRF staff members inspect this box monthly. When full, the box is sealed and disposed with the laboratory trash.

### SECTION 5.2: HIGH VOLTAGE HAZARDS

The following instruments inside the XRD use High Voltages:

- Rigaku Ru-300 XRD
- Haskris Chiller

All MCF users are given proper instruction on equipment operation before given authorization to use these tools. Users must follow all operational procedures outlined in the Standard Operating Procedures located in Appendix C.

**WARNING:** Users are not permitted to enter areas outlined areas marked with RED/WHITE warning tape as there is a risk for potential injury due to connections to high voltage equipment.

**WARNING:** Any attempt to bypass any safety interlocks on any piece of equipment in the cleanroom may result in severe shock or electrocution.

The XRD equipment utilizes high electrical voltage. Users are permitted to operate the equipment, but not to service. User must follow all operation procedures outlined in the Standard Operation Procedures located in Appendix C. All equipment issues must be brought to a MCF staff attention. The tool must be disconnected from the power supply before being serviced.

## SECTION 6: RADIATION HAZARDS

The Rigaku Ru-300 XRD is an x-ray producing device. X-rays are harmful to human body and can cause serious injury if proper protocols are not followed.

The Rigaku Ru-300 XRD is located in 402A which is built to be a radiation enclosure for the system. This include lead doors, lead covered walls, and MED-X safety glass.

### SECTION 6.1: RADIATION EFFECTS ASSOCIATED WITH XRD

The Rigaku Ru-300 XRD is an x-ray producing device. X-rays are harmful to human body and can cause serious injury if proper protocols are not followed. Two types of injuries can occur when operating the XRD and are characterized by when the effects appear:

#### Acute Effects

Acute Effects of x-ray radiation exposure occur soon after the individual is exposed to x-ray radiation. These effects include discernible radiation burns, reddening of the skin known as Erythema, and hair loss

#### Delayed Effects

Delayed Effects of x-ray radiation exposure occur months or years after the individual is exposed to x-ray radiation. These effects include cancer and cataracts (when the exposure occurs to the lens of the eye).

*WARNING: Radiation exposure cannot be sensed by the human body at the time it occurs. If possible exposure occurs, contact the Radiation Safety Office immediately and arrange for a medical examination. Be sure to inform the physician that exposure to low-energy x-rays may have occurred.*

### SECTION 6.2: RADIATION PROTECTOIN

To adequately monitor exposure to x-ray radiation, users are required to be wearing a radiation badge at all times when operating the XRD.

Always remember the radiation protection principles when operating the XRD:

1. **TIME:** While operating the XRD, work cautiously, quickly, and efficiently to minimize time spent in room 402 while the XRD is energized.
2. **DISTANCE:** Remain as far away as possible from the x-ray radiation source to minimize body exposure.
3. **SHIELDING:** Do not bypass any safety interlocks associated with the XRD. Ensure that the shutters are NOT open when entering 402. This is done by verifying that the shutter

lights are not illuminated and that the shutter positions are in the EXT position at all times.

**WARNING: NEVER PLACE ANY PART OF YOUR BODY IN THE PATH OF THE X-RAY BEAM. THIS CAN RESULT IN PERMANENT PHYSICAL BODY DAMAGE!**

The **CAUTION ITEMS** listed below should be followed to limit exposure while operating the Rigaku XRD Ru-300:

- During alignment procedures, the system should be operated at the minimum power of 20kV and 10mA to minimize the x-ray intensity and the 402A entrance door left open. This will allow a user to be in control of shutter operation at all times by controlling the shutter toggle switch position.
- During alignment procedures, minimize shutter open time as much as possible.
- When the X-ray generator is operating, the RED warning light above the computers will be illuminated. Do not enter room 402A if the RED warning light is illuminated. The only time a user is permitted to enter 402A with the RED warning light illuminated is during alignment procedures.
- Never expose any place any part of your body in the direct patch of the x-ray beam. **THIS CAN RESULT IN PERMANENT PHYSICAL BODY DAMAGE!**
- Never close the doors to 402A while working in 402A with the system operating. This will prevent the shutters from the system from accidentally opening during alignment procedures as the safety interlock will be deactivated.
- Do NOT operate the tool in a manner which is not specified in the XRD SOP.

Additional information is found in Appendix A of the CHP or at <http://www.hsc.wvu.edu/rsafety/Radiation-Safety-Manual>

## **SECTION 7: STANDARD OPERATING PROCEDURES**

The Rigaku RU-300 XRD is used for crystal structure and thickness characterization of thin films and powders. Standard Operating Procedures for the system are found in the Appendix C of the XRD Lab CHP

## SECTION 8: LAB SPECIFIC EMERGENCY PROCEDURES

1. Instrument shut down procedures are to be performed only by the MCF staff and experienced users who are qualified to do so by the MCF staff.
2. In case of compressed gas emergency, exit the building and notify safety personnel immediately.
3. In case of fire, evaluate the building and call **9-911**.
4. In case of unplanned power outage, the instruments will shut-down automatically. See Power Loss SOP and contact a MCF staff immediately.
5. In case of unplanned water outage, the instruments will shut-down automatically.
6. For other lab equipment:
  - a. Shut off all surge protectors to the computer.
  - b. Shut power off to all in-use equipment.

## SECTION 9: ADDITIONAL ITEMS

1. Visitors are not permitted in the lab unless authorized by the MCF staff.
2. Replace wipes and gloves when their supplies are running low.
3. Clean nitrile gloves are to be worn at all times when handling samples.
4. If you use up any item (*e.g.*, gloves, wipes, sticky tabs, *etc.*), notify MCF staff.



UPDATE: 08 August 2013

**APPENDIX A:  
ADDITIONAL RADIATION SAFETY INFORMATION**

UPDATE: 08 August 2013

**APPENDIX B:**  
**MATERIALS SAFETY DATA SHEET (MSDS)**

UPDATE: 08 August 2013

**APPENDIX C:**  
**EQUIPMENT STANDARD OPERATION PROCEDURES**