Welcome

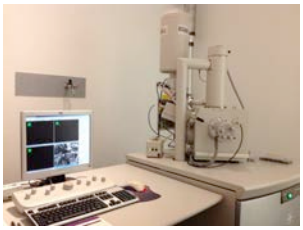
Welcome to the Imaging and Microscopy Facility (IMF) at UC Merced. The IMF suite hosts optical, scanning and transmission electron microscopes, in addition to equipment for preparing specimens for examination. We serve campus researchers in the physical sciences, biological sciences, and engineering; and have a particular focus on *nanotechnology*. This facility offers students and researchers a range of materials characterization techniques, including advanced imaging, elemental analysis, and structure determination.

Major Instrumentation

ZEISS Gemini 500

The Gemini objective lens design combines electrostatic and magnetic fields to maximize optical performance while reducing field influences at the sample to a minimum. This enables excellent imaging, even on challenging samples such as magnetic materials. The Gemini detection concept ensures efficient signal detection by detecting secondary (SE) and backscattered (BSE) electrons in parallel. These so-called Inlens detectors are arranged on the optical axis, which reduces the need for realignment and thus minimizes time-to-image. Gemini beam booster technology guarantees small probe sizes and high signal-to-noise ratios, right down to very low accelerating voltages. It also minimizes system sensitivity to external stray fields by keeping the beam at high voltage throughout the column until its final deceleration.

FEI Quanta 200 ESEM



Environmental scanning electron microscope (ESEM) with a tungsten filament and EDAX Genesis energy-dispersive X-ray spectrometer 30mm^2 detector with 132 eV resolution. The microscope has 4 nm spatial resolution and can detect characteristic X-rays down to and including beryllium, although sensitivity is limited for light elements. It can operate in the low vacuum range (10^{-3} to 0.8 Torr) and in environmental mode (0.1 to 40 Torr). In the environmental mode, it is possible to examine samples from at 100% relative humidity, making this a very versatile instrument. The EDAX Genesis software allows the user to collect spectra and elemental maps in both manual and automated modes. With this instrument, it is possible to view and perform x-ray analysis on non-conducting samples or 'wet samples' without having to coat or dry.

JEOL JEM-2010 HRTEM

High-resolution transmission electron microscope with LaB_6 filament and Gatan GIF camera with 1.6 eV energy resolution. This instrument is capable of 2.4 Å point-to-point image resolution and 1.4 Å lattice fringe resolution. The Gatan GIF provides for the collection of electron-energy loss spectra and maps, in either nanoprobe (10 nm) or TEM mode. Electron energy-loss spectroscopy can be used for many purposes. It is very sensitive to light elements and complements another TEM technique (energy dispersive X-ray spectroscopy) that is most commonly used for heavier elements. It also can be used to determine plasmon energy, band gap, coordination, oxidation state, and many other material characteristics at a spatial resolution of about 10 nm in the nanoprobe mode. Soon, this instrument will have a cryo-transfer holder/stage and energy dispersive X-ray spectrometer. Cryomicroscopy is very useful for reducing damage rates minimizing carbon contamination and in soft materials.

PANalytical X'Pert PRO XRD

The X'Pert PRO X-ray diffraction system is the basic platform for a wide variety of applications in analytical X-ray diffraction, in both scientific and industrial research environments. The modular design utilizing the PreFIX concept makes it possible to preform more than one type of analysis on one system. We are configured with a Cu source. High performance theta/theta goniometer, accuracy +/- 0.0025 degrees, reproducibility +/- 0.0001 degrees, scan speed 0.001 to 1.27 degrees per second, slew speed 10 degrees per second, minimum step size 0.0001 degree. Two theta measuring range 0 to 167 degrees. The x'celerator is an ultrafast detector for powder diffraction.

Support Instrumentation

Minor instrumentation available in the facility includes:

- Optical Microscopes - Stereo-zoom microscope and compound light microscope
- Specimen Preparation - Equipment includes a critical point dryer, sputter-coater, vacuum evaporator, and ultra-microtome, dimpler
- Computers - Equipped with materials science software and off-line processing capabilities for data obtained from the major instruments

Services

We can provide training, technical and scientific support, teaching support, outreach support, and assistance in preparing research proposals that require the services of our facility or that focus on electron microscopy instrumentation. We also stock supplies that many of our users need, and we can even come to your classroom to give a lecture or demonstration.

Contacting Us

Please contact Mike Dunlap (658-3020, mdunlap@ucmerced.edu) if you have any questions about this facility or how it can help you in your research, teaching and other programs, or visit our web page at www.imf.ucmerced.edu.

Imaging and Microscopy Facility
Getting Started

The Imaging and Microscopy Facility is unique on this campus in terms of the scope of its role in teaching and its open access policy for all of its users. With a large number of students per year coming through the laboratory, it can be a challenge to keep track of everyone. Therefore, we ask that each of our users go through the following three-step process that will help us to set up your account, take care of your safety training requirements, and issue you access rights.

Step 1. Recharge Authorization

We require that everyone working in the IMF facility fill out a recharge authorization form. This form, signed by your supervisor or the account's manager, provides essential account information that is needed when billing for services rendered. Even if you are not planning to use a recharge-supported instrument, such as an electron microscope, we still need this information in case you wish to purchase some supplies, or your work results in damage that is beyond what is normally considered wear and tear, or an innocent accident.

Step 2. Laboratory Safety

Laboratory safety is not limited to just the issue of personal injury but includes the condition of the instrumentation, support equipment and facilities. We all must use these resources to be able to get everyone's work done. Providing a safe workplace and proper safety training is also mandated by the University, by Cal-OSHA, and by other organizations and regulatory agencies. The safety policies and procedures in effect in this facility are designed to address these issues. We have created a straightforward safety training and record-keeping procedure that complies with these requirements. This is designed to get the user up to speed in the facility with minimum delay.

Initial Training: If not done so, please complete UCM's EH&S Laboratory Safety Fundamentals class. When you have completed this class, come to the lab for a brief orientation and we will show you where the safety equipment is located, where the chemicals are stored, etc. We will fill out our form and you and our staff will sign the document. We will keep it in your file along with other training records.

Instrument-specific Training: One of the facility's most basic policies is that each person must receive, at minimum, basic training on each instrument they are using. Training on the smaller instruments generally takes only 10-15 minutes, which is designed to show you how to operate the instrument properly. This will help you get the best possible results with the least amount of effort. Do not operate any equipment in the facility without this instrument-specific training. Records of all such

training will be kept in your file.

Step 3. Access Rights
You can request access rights that will allow you to enter the laboratory 24 hours a day, 7 days a week. Issuing of access rights is done in accordance with the University's key/card control policy. This policy defines who can be issued a key/card, record keeping requirements, etc. This facility also has a few additional requirements.

- You must be a UC Merced employee, a graduate student, or an active undergraduate researcher
- You must meet the minimum laboratory and workplace safety training requirements for the facility
- We must have your recharge-authorization on file
- You must not share your access card with anyone
- You must have completed the Instrument training for the room you wish access to

If the above requirements are met, the IMF facility personnel will authorize UCM's lock shop to update your access card.

Imaging and Microscopy Facility
Important Policies

IMF offers a selection of very capable and rather expensive characterization instrumentation, easy access to this instrumentation 24 hours a day, 365 days a year, and serves a number of researchers and many students, all with nominal staffing and operating funds. The continued operation of this facility depends as much on the courtesy and care our users show for the equipment they are using, as it does on the actual services provided. The secret of success is due in large part to the cooperation and support of our users. We have established a laboratory culture where people ask for help when needed, report problems with equipment promptly, clean up after themselves, and generally show that they appreciate having the facility here and are aware of how important small gestures can be when sharing equipment with others. As much as we have relied on and genuinely appreciated this cultural element of the facility, we do have a few basic policies, summarized below, that we can fall back on and, when necessary, enforce.

1. Policy on Damages Incurred

Accidents happen. That is to be expected, though not frequently, and we do realistically expect a certain number of minor accidents to occur during the year. Too often, however, things get broken because of a lack of basic competence on an instrument, not following operating procedures, safety procedures, other guidelines or limits such as what types of specimens one can analyze in the SEM or TEM, or general sloppiness or risk-taking with our equipment. In these cases, we will charge your account for the damages incurred, whether they are to an instrument or to the laboratory, involve chemicals or tools, or even theft that occurs due to misuse of your access card or propping doors open, allowing anyone to come in.

2. Policy on the Use of Chemicals in the Facility

Our policies on the use of chemicals in the laboratory are spelled out clearly in the "Initial Safety Training" booklet. Briefly, this policy states that acutely hazardous materials cannot be used in this laboratory, your chemicals cannot be stored in the facility, we do not dispose of your chemicals for you, and you are responsible for knowing how to use, store and dispose of the chemicals. You must carry an MSDS sheet of any chemical brought into the facility.

3. Policy on Food in the Laboratory

Briefly, this policy is, no food or beverage may be consumed or stored anywhere in the facility except in designated areas. These designated areas are:

- Currently, there are no designated areas.

4. Policy on Specimens Left in the Laboratory

Do not leave your specimens in the facility. We cannot guarantee that no one will tamper with them or that they will

even be there when you return. Specimens left in the facility for more than 14 days will be disposed of. Any cost of disposal will be charged to your account.

5. Policy on Non-University Work Performed in the Facility

The University has strict policies on using University facilities for personal or commercial uses. For the purposes of this facility, a simple definition of such activities would be those that cannot be recharged to a UC Merced account. The facility's policy is that no such work can be done by users using IMF equipment.

6. Policy on Publishing Data Acquired Using the Facility

We require that all publications/talks/posters acknowledge the Imaging and Microscopy Facility at UC Merced. Acknowledgement of any facility personnel is at your discretion. Please submit paper copies or PDF files. They will be used for tracking purposes and will become part of the facility's year-end report.

Recharge Authorization form must be completed before using IMF Facility

Date:_____

User authorization for the IMF requires agreement by the Principal Investigator to the policies listed below:

Principal Investigator _____

School _____

Email _____ Phone _____

I authorize the following individual to use the IMF Facility:

Name _____ Employee ID Number _____

School _____

Email _____ Phone _____

Status: ☐ Faculty ☐ Staff ☐ Student ☐ Post-Doc ☐ Visitor

FAU Information: Account (6 Characters)-Cost Center (2 Characters) -Fund (5 Characters) -Project (up to 5 Characters)
Start and End Date

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INSTRUMENT AND SPECIMEN CARE

When the user functions as the operator of any instrument in this Facility, he / she assumes full responsibility for any damage to the instrument caused by operator neglect or inappropriate specimens. It is the operator's responsibility to acquire sufficient instrument training to qualify as a competent operator.

Specimens left in the laboratory for preparation and / or analysis will receive professional care. However, neither the Facility, its employees, nor its users are responsible for accidental damage to or loss of specimens. Specimens left in the laboratory for more than 14 days will be subject to discard at the PI's expense unless special arrangements are made.

REPORTING REQUIREMENTS

We require that all publications/talks/posters acknowledge the Imaging and Microscopy Facility at UC Merced. Acknowledgement of any facility personnel is at your discretion. Paper copies or PDF files will be used for tracking purposes and will become part of the facility's year-end report.

I understand the instrument, specimen care, and reporting requirements of the Imaging and Microscopy Facility. Continued certification as an authorized user requires compliance with the above policies. I authorize the above named individual to use the IMF facility and expenses incurred should be billed to the above account.

Principal Investigator's Signature _____ Date_____