University of Wisconsin-Madison

Characterization Lab for Irradiated Materials

Characterization Lab for Irradiated Materials (CLIM)

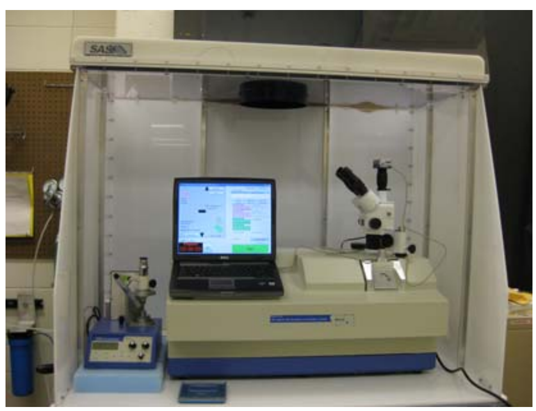
Electron Microscopy Laboratory (EML)

The EML at University of Wisconsin-Madison is capable of examining neutron-irradiated transmission electron microscopy (TEM) specimens. The sample preparation equipment available includes a Jet Electropolisher (Southbay 550D), Ion Mill (Fischione Model 1010) and Dimpling Grinder (Fischione Model 200). All are placed in a fume hood equipped with a HEPA filter. Metal, ceramic, and graphite specimens can all be prepared.

The JEOL 200CX transmission electron microscope is a dedicated microscope for the microstructural examination of radiologically hot samples. The microscopy is a 200kV analytical TEM/STEM with a LaB6 source. It has a lattice resolution of 0.45nm and magnification ranges from 100X-330kX. The microscope is equipped with energy dispersive X-ray spectroscopy and a full range of sample holders, including heating, cooling and double tilt analytical holders.

JEOL 200CX TEM equipped with EDS and scanning system

Electropolisher

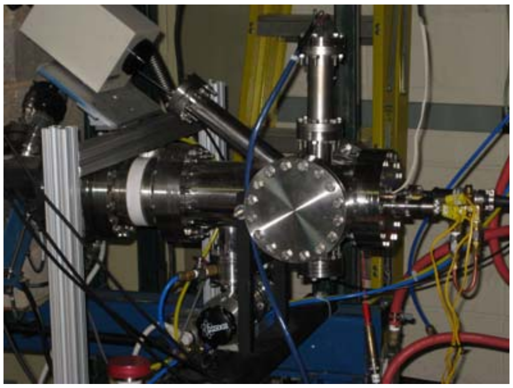


Dimpling grinder and Ion mill

Tandem Accelerator Ion Beam

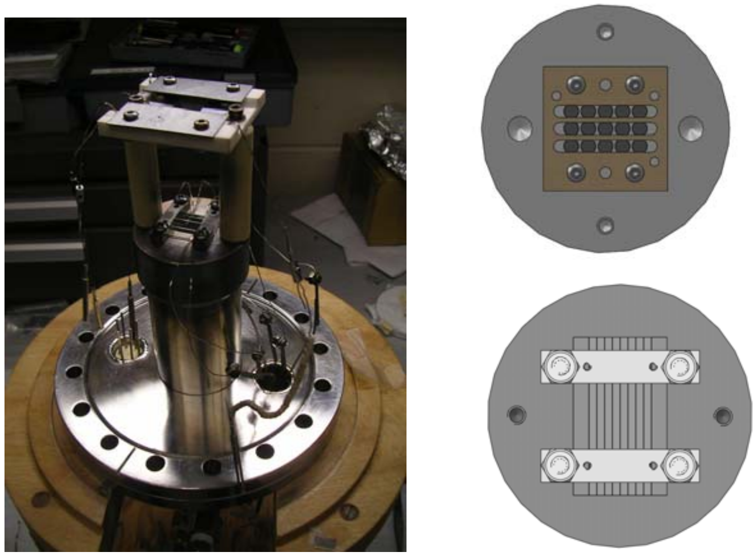
High-energy ion beams can be produced with a 1.7 MV terminal voltage tandem ion accelerator (Model 5SDH-4, National Electrostatics Corporation Pelletron accelerator) installed at the UW-Madison. The accelerator features dual ion sources for producing negative ions with a sputtering source or using an RF plasma source. This versatility allows for ion beam production of nearly any element (several rare earth elements do not form negative ions). The sources produce ion beam currents ranging from a few μA for the gaseous elements (e.g. He and N from the RF source) to ~1 mA for elements like silicon used for ion implantation. Negative ions are accelerated to 1.7 MV at the terminal where they then undergo electron stripping in a N_2 gas chamber. The positive ions are then further accelerated to ground potential at the accelerator exit. Therefore, for an ion with charge Z, the available ion energy is 1.7 MV x (Z+1), and the maximum ion energy available is ~ 10 MeV (e.g., for silicon) and mostly depends on the stripping efficiency of the ions into the higher charge states. At the exit from the accelerator tank, a quadropole magnet shapes the beam. Finally a single ion charge state / energy is selected by a switching magnet that sends the beam down to one of 2 beam-lines attached at different angles. Faraday cups and beam profile monitors are also installed to measure beam current and shape respectively. A feedback system maintains the ion beam energy constant to within +/- 500 V. The accelerator operates in steady-state.

Tandem Accelerator Ion Beam



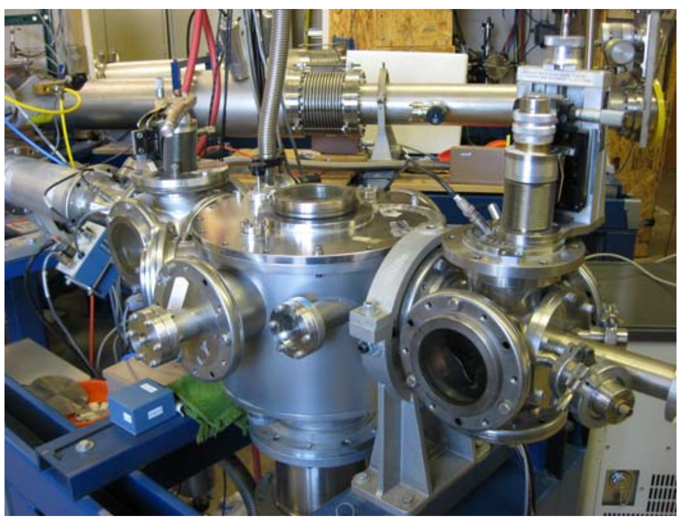
Irradiation beam terminal

The ion irradiation beam line is equipped with a sample stage which incorporates heating and cooling capabilities and a reliable method for positioning and securing samples which minimal interference with the monitoring equipment and the ion beam. Samples can be irradiated over a high temperature range from 200°C to 1400°C. Both 3 mm TEM specimen and bar-shaped coupon samples can be mounted and irradiated.



Proton irradiation sample stage, capable of hosting bar and disc shaped specimens.

The analysis beam line is capable of Elastic Recoil Detection (ERD/RBS) and Nuclear Reaction Analysis (NRA) analysis.



Analysis beam line terminal