ION ACCELERATOR LABORATROY
AT TEXAS A&M UNIVERSITY

A US Department of Energy NSUF User Facility

- Provides ion irradiation testing, ion implantation, surface modification, and ion beam analysis of materials
- Offers service and collaboration to national laboratories, industry, and university researchers

Point of contact: Dr. Lin Shao, lshao@tamu.edu, 9797778728

Accelerators

Voltage	Ion source	Ions and beam energies
10 kV	Gas ion source	H, He, C, O, N, Ar, etc.., 5 keV to 20 keV
140 kV	Gas ion source	H, He, C, O, N, Ar, etc.., 50 keV to 280 keV, depending on ion charges
400 kV Van de Graaff	Gas ion source	H, He, N, Ar, Xe, Kr, 200 keV to 1.2 MeV, depending on ion charges
1.7 MV General Ionex	Sputtering + plasma dual ion source	Almost all ions from the elemental table, 800 keV to 3.5 MeV
3 MV NEC tandem	Sputtering + plasma dual ion source	Almost all ions from the elemental table, 800 keV to 8 MeV

Key capabilities

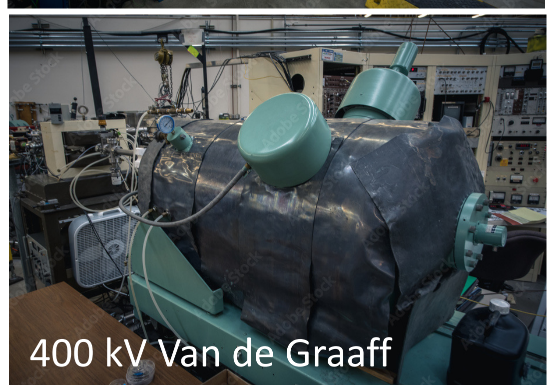
Ion irradiation testing	Liquid nitrogen to 1200°C, up to 1000 displacement per atom (dpa)	Nuclear fuels, fission reactor materials, fusion reactor materials, radiation detector, sensor, microelectronics devices,
Ion implantation	Liquid nitrogen to 1200°C, 1×10^{13} to 1×10^{16} ions/cm^2	Semiconductor doping of a wide range of materials including Si, Ge, II-VI, III-V compounds, diamond, etc.
Ion beam analysis	•Rutherford backscattering spectrometry •nuclear reactor analysis •elastic recoil detection analysis •particle-induced X-ray emission •beam-induced charges	

Significance and impact

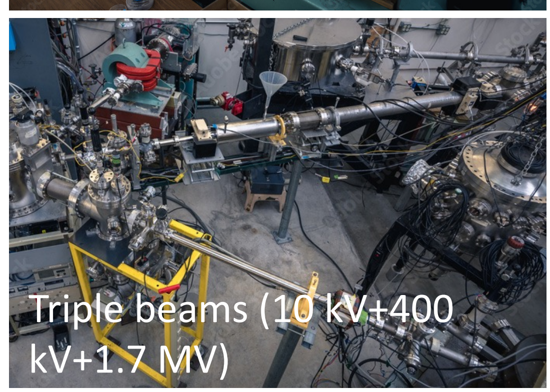
- Standardize testing procedures and contribute to the development of testing methodologies.
- Play significant roles in both fusion reactor and fusion reactor materials testing, screening, ranking, and optimization
- Offer irradiation testing at an damage rate several orders of magnitude higher than typical reactors
- Can reach about 100 displacements per atom per day at temperatures up to 1200°C
- Developed unique methods for contamination-free irradiation and prolonged testing

3 MV beam lines

3 MV acceleration tank



400 kV Van de Graaff

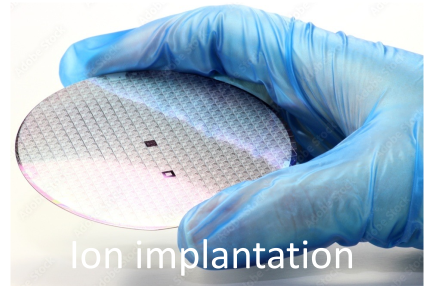


Triple beams (10 kV+400 kV+1.7 MV)

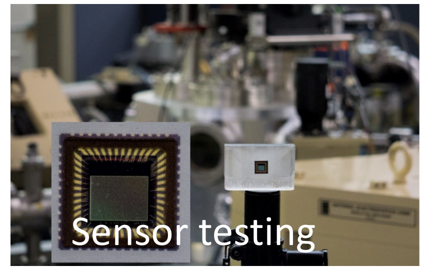
ION ACCELERATOR LABORATROY
AT TEXAS A&M UNIVERSITY

A US Department of Energy NSUF User Facility

Point of contact: Dr. Lin Shao, lshao@tamu.edu, 9797778728


Ion implantation

Ion doping and surface modification: The lab excels in providing precisely controlled ion doping services to a wide range of semiconductor materials. With the capability of rastering beams over wafers up to 6 inches in diameter, the lab ensures uniform and accurate doping profiles. The vacuum conditions are maintained at a typical level of 1×10^{-7} torr or better, ensuring a clean and controlled environment for the ion implantation process.


Sensor testing

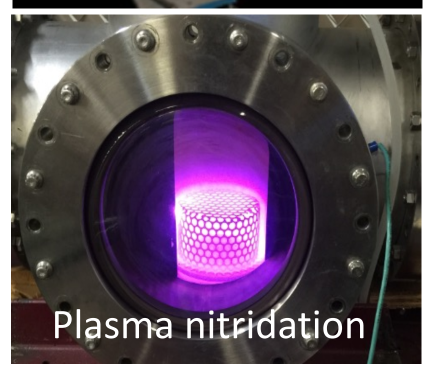
Ion irradiation of radioactive materials: The lab holds a state of Texas license that allows handling and irradiation of radioactive materials. Typical examples include ^{238}U, ^{232}Th, and minimized specimens of reactor-used components. With well-designed shielding and guaranteed safety measures, the lab ensures the protection of users and operators during ion irradiation experiments with radioactive materials.

Simultaneous multiple beam irradiation: The lab's capability to irradiate materials simultaneously with hydrogen, helium, and heavy ions allows researchers to investigate the combined effects of these particles on materials. This is crucial to emulate fusion reactor first wall conditions.


High resolution RBS

High-resolution RBS (the only one in US): RBS is a powerful non-destructive analytical technique used to study the composition and structure of materials. The use of a 90-degree bending magnet and 2-D detector matrix enables the system to resolve the energy of each scattered ion with a remarkable resolution of 1 keV. The system boasts an impressive depth resolution of one angstrom (Å).

In situ corrosion, irradiation, and characterization: With a recent infrastructure grant from the US DOE, the lab has developed the capability to irradiate materials in a molten salt corrosion environment. Additionally, a high-temperature operable RBS spectrometer was designed, enabling in situ characterization of the corrosion rate.


Plasma nitridation

Cutting-edge plasma nitridation: The lab developed its own cathodic cage plasma nitridation chamber, which allows for a much better uniformity in the nitriding process. This is particularly important for nitriding materials with complicated geometries, such as components used in space reactors. Nitridation improves wear resistance and hardness. Some alloys experience improved corrosion resistance and radiation tolerance.


Molten salt corrosion

Development of ion source and accelerator components: The lab possesses the capability and is actively engaged in advancing ion source and linear accelerator components to meet the industry demands. Examples include the development of a filament-free ion source, a radio-frequency quadrupole, and drift tube accelerators. These innovations aim to improve the efficiency, reliability, and performance of ion beam systems for medical isotope production and particle accelerator research.

Rapid turnaround and professional assistance: The lab members include experienced technicians, senior scientists, and more than 10 accelerator operators. The lab runs 24x7. The lab provides experimental design assistance to customers with a strong background in various simulation and modeling capabilities.