

Crystal Growth Research Facilities

A considerable amount of specialized equipment, much of which is unique, has been accumulated and developed as a result of our research activities. Our philosophy when developing new equipment has been to try to extend the range of materials properties (vapour pressure, melting point, reactivity and radioactivity) with which we can cope. Thus, we are now able to prepare samples with melting points in excess of 2500 K, to handle reactive and radioactive materials and to work with samples which have all but the very highest vapour pressures.

Our purification research has encompassed zone refining, sublimation, solid state electrotransport and vacuum melting, and we have used these techniques to refine several elements to the highest purities ever reported. Our crystal growth facilities have been similarly developed so that we can now grow crystals under UHV-rated conditions using the Czochralski, float zoning, Bridgman and solid state techniques. In 2003, the group acquired a crystal growth image furnace which gave us the means to expand our activities from almost exclusively metallic systems to non-conductors such as oxides.

A full list of our facilities:

1. Sample melting equipment

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- Large arc furnace : For samples up to 5 cm
- Small arc furnace : Includes welding facility for sealing crucibles
- High pressure arc furnace : For melting high vapour pressure materials
- UHV cold boat : For high purity materials with low to medium vapour pressures
- Dedicated UHV cold boat : Dedicated to U and Th work
- High vacuum cold boat : For general purpose melting

2. Crystal growth systems

- Czochralski, high vacuum : For general purpose crystal growth of large crystals, using either hot or cold crucibles
- Czochralski, UHV : For high purity crystals
- Bridgman : Using open or sealed crucibles
- Tri-arc : For crystals of high melting point metallic materials
- RF float zoning, high vacuum and UHV : For preparing single crystal rods of many elements and compounds
- Optical floating zone furnace (image furnace) : For growth of rod shaped crystals of both metals and metal oxides
- Horizontal zoning : For materials not amenable to float zoning
- Solid state growth : For alloys and some elements with a phase transformation

3. Purification equipment (all UHV)

- Zone refining : For general refining of low to medium vapour pressure materials
- Sublimation : For high vapour pressure elements
- Electrotransport : For purifying reactive metals with respect to O, N, C and H

4. Heat treatment system

- UHV : Mainly used for degassing samples, particularly w.r.t H
- High vacuum tube furnaces : For long term heat treatment (0-1200 C)
- Sintering furnaces : Horizontal, vertical and box furnaces for sintering and annealing

5. Specimen preparation and characterization

- Spark machines : Fabricating specimens (one dedicated to U, Th work)
- X-ray Laue equipment : Checking crystallinity and aligning crystals
- X-ray diffractometer and generator
- X-ray Debye Scherrer cameras and generator
- Diamond saws : Cutting specimens and preparing oriented single crystals
- Density measuring equipment
- Optical microscopes
- Metallographic polishing wheels
- Goniometers
- Glove box assembly : For U and Th work

For detailed microstructural characterization and analysis, the Group has access to the department's state of the art SEM and TEM facilities.

6. Ancillary equipment

- RF generators : For induction heating

- Inert gas purifiers : Purifying commercial inert gases
- Vacuum stores : For storage of reactive materials
- Mobile dust extractors : For cleaning equipment contaminated with U, Th
- Weighing balances

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