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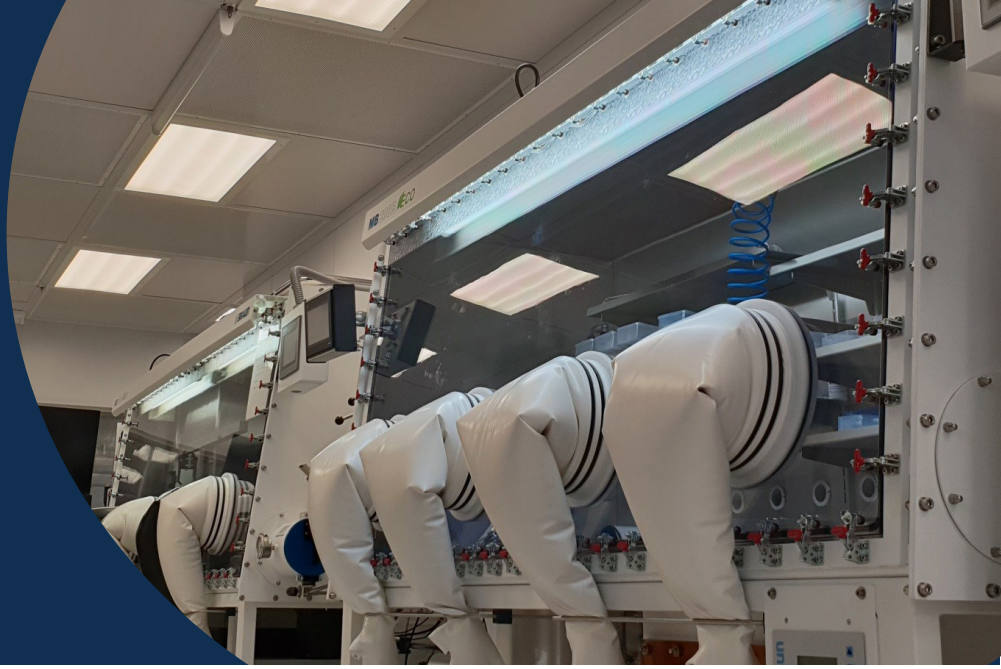

INERT GAS FACILITY

Overview
Different mechanically exfoliated 2D crystals can be stacked into heterostructures creating next-generation materials, with unique electrical and optical properties. Some exfoliated 2D crystals must be processed under a protective inert atmosphere to prevent contamination or degradation. This facility combines five capabilities, necessary for the fabrication of and processing of high quality tailored heterostructures.

The inert gas facility has the capability to: exfoliate 2D crystals under an inert atmosphere; stack multiple crystals to make heterostructures; spin coat protective coatings and lithography resists; metallise using electron beam and thermal evaporation; etching and annealing of prepared substrates and samples in Ar, O_2 and Ar:H_2 atmospheres.

The inert gas facility is a critical component of the National Graphene Institute's fabrication machinery.

Capability profile
The inert gas facility allows for the fabrication of heterostructures from exfoliated lamella materials such as graphene, h-BN and TMDCs. The ability to exfoliate and encapsulate air sensitive materials within an inert atmosphere allows for the creation of unique structures, previously unattainable with traditional techniques.

Mechanical stacking: a semi-automated stacking system, which is compatible with both the common stacking techniques using PMMA and PDMS. The two stages, plectrum and sample, both have 4 degrees of freedom and the sample stage has a heater. A high resolution camera coupled with long working distance optics, allow for heterostructures to be fabricated with micron resolution.

Spin coating: a spinner capable of spin coating a range of polymers such as PMMA, PMGI, PDMS and Copolymer. Spin speeds range from 1000rpm to 7000rpm in order to control film thickness and uniformity. The films can then be used for lithography or as a protective coating.

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Physical vapour deposition: a high vacuum chamber capable of depositing thin films using either thermal evaporation or electron beam evaporation. The system is equipped with the following specifications:

Base vacuum: <5E-7 mBar with a cycle time of less than one hour.

A thermal evaporation boat, suitable for most non-refractory metals used to make ohmic contacts.

An electron beam turret with 4 pockets, allowing for multiple materials to be evaporated, suitable for ohmic, superconducting and some insulating films.

Annealing Chamber and Etching Chamber: a high vacuum chamber capable of thermally annealing and plasma cleaning samples, in vacuum or a controlled atmosphere. The system is equipped with the following specifications:

Base vacuum: <5E-7 mBar with a cycle time of less than one hour.

A two-inch heated stage, capable of heating to 1000C.

A three-inch plasma stage, with a maximum power of 30W.

Upstream pressure control with three different gases, Ar_2, O_2 and Ar_2/H_2.

Recipe control allows for the automation of processes.

Glovebox: a controlled inert gas glovebox with control of oxygen and water levels, connecting all other process equipment.

Inert gas: Ar_2

Water content < 1ppm

Oxygen content < 1ppm