nanoETCH

Soft-etching system for graphene and 2D materials

Key features:

- Graphene and 2D materials soft-etching
- Substrate/support conditioning for mechanical exfoliation
- Precision RF powers < 30 W
- Up to 3 MFC-controlled process gases
- Fully automatic operation via touchscreen HMI
- Up to 6” diameter stages
- Base pressures < 5×10^{-7} mbar
- Define/save multiple process recipes
- Automatic pressure control option
- Easy servicing
- Comprehensive safety features
- Cleanroom compatible
- Proven performance

MOORFIELD
NANOTECHNOLOGY

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Registered in England and Wales with company number 3044718.

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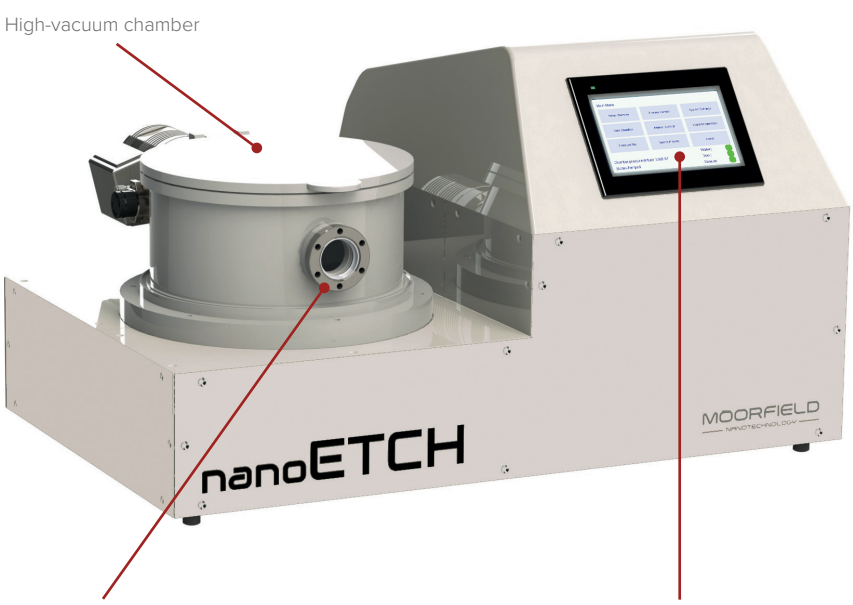
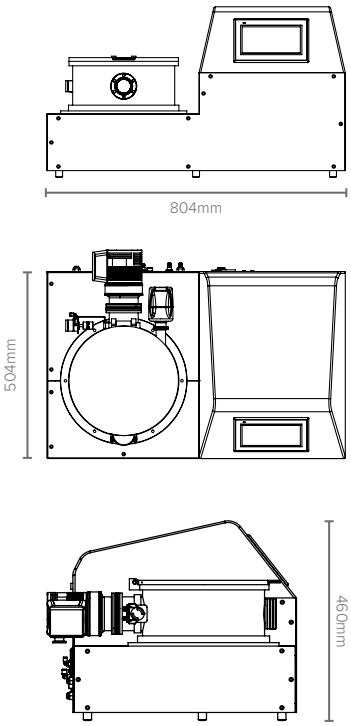
Overview:

The nanoETCH implements Moorfield's unique soft-etching technology and provides the fine etching control crucial for graphene and 2D materials research in a convenient, benchtop package.

Recently released by Moorfield following extensive collaboration with academic partners including the graphene group at Manchester University, UK, the nanoETCH series has been designed for etching applications needed as part of R&D work based on 2D materials including graphene. The instruments, which are fully automatic and touchscreen-operated, are equipped with precisely-controlled RF power generation and process gas introduction and are ultra-compact for benchtop location.





Soft-etching technology:

Unlike conventional etching systems, nanoETCH systems from Moorfield are optimised for 2D materials R&D through the precise delivery of low plasma-etching powers, technology referred to as soft-etching. Such fine control is essential for researchers working with layered materials with characteristic dimensions on the single-atom scale.

Examples of specific applications for which nanoETCH tools are now proving critical include:

Substrate preparation for mechanical exfoliation:

When preparing 2D material 'flakes' via mechanical exfoliation (also known as the sticky-tape method), the nature of the substrate surface is crucial. Moorfield nanoETCH tools are now being used to obtain the topological and chemical substrate surface properties necessary for producing large flake areas.

2D material patterning:

Given their thinness, 2D materials are fragile and require finely-controlled etching conditions for device fabrication. Soft-etching technology provides this control, and also allows for patterning without cross-linking common mask photoresists (e.g., PMMA).

Defect engineering:

A key research theme for graphene science is bandgap engineering. Through controlled low plasma-powers, nanoETCH systems are being used for creating point defects in lattices for implementing control over this aspect of the material. A soft-etching approach is necessary for reproducible results and to avoid uncontrolled material destruction.

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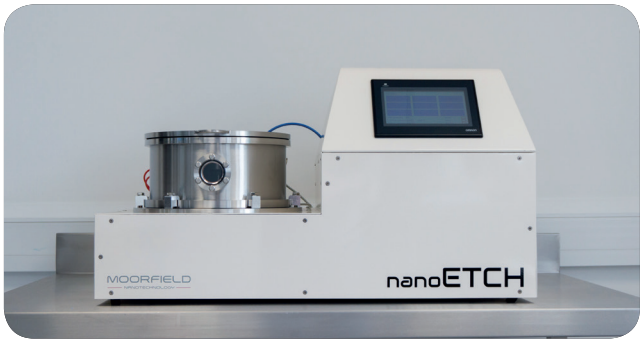
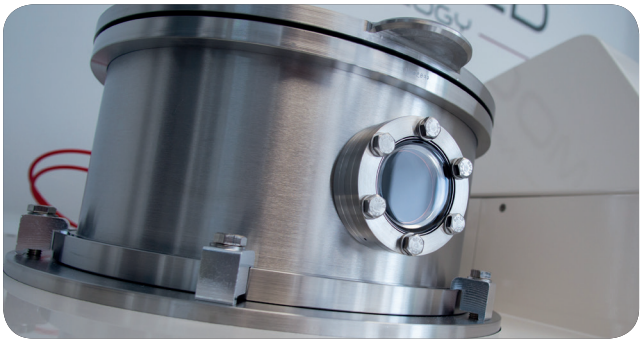
Configuration:

The system contains, at its core, a stainless-steel process chamber fitted with a central, isolated substrate stage that is electrically connected to an RF power supply. The system has a modular design allowing for easy disassembly and routine maintenance, and is fitted with a turbomolecular pumping system for 10^{-7} mbar base pressures. Dry pumping is available as an option. As standard, the tool is equipped with one mass flow controller (MFC) for process gas introduction (argon), but can be upgraded with up to three (e.g. for O_2 & N_2).

Pressure control is upstream, with operators setting MFC flow rates to achieve the required atmosphere. Optionally, a capacitance manometer can be included that allows for high-accuracy, fully-automatic pressure control with 1 mTorr resolution. The RF power supply includes an automatic matching unit and is purpose-configured for the nanoETCH range. In particular, it provides high stability at the low output levels (< 30 W) necessary for soft-etching, with control resolution down to 10 mW. At all times, users have access to information such as forward, reflected and plasma powers, tune and load capacitor positions, and DC bias.



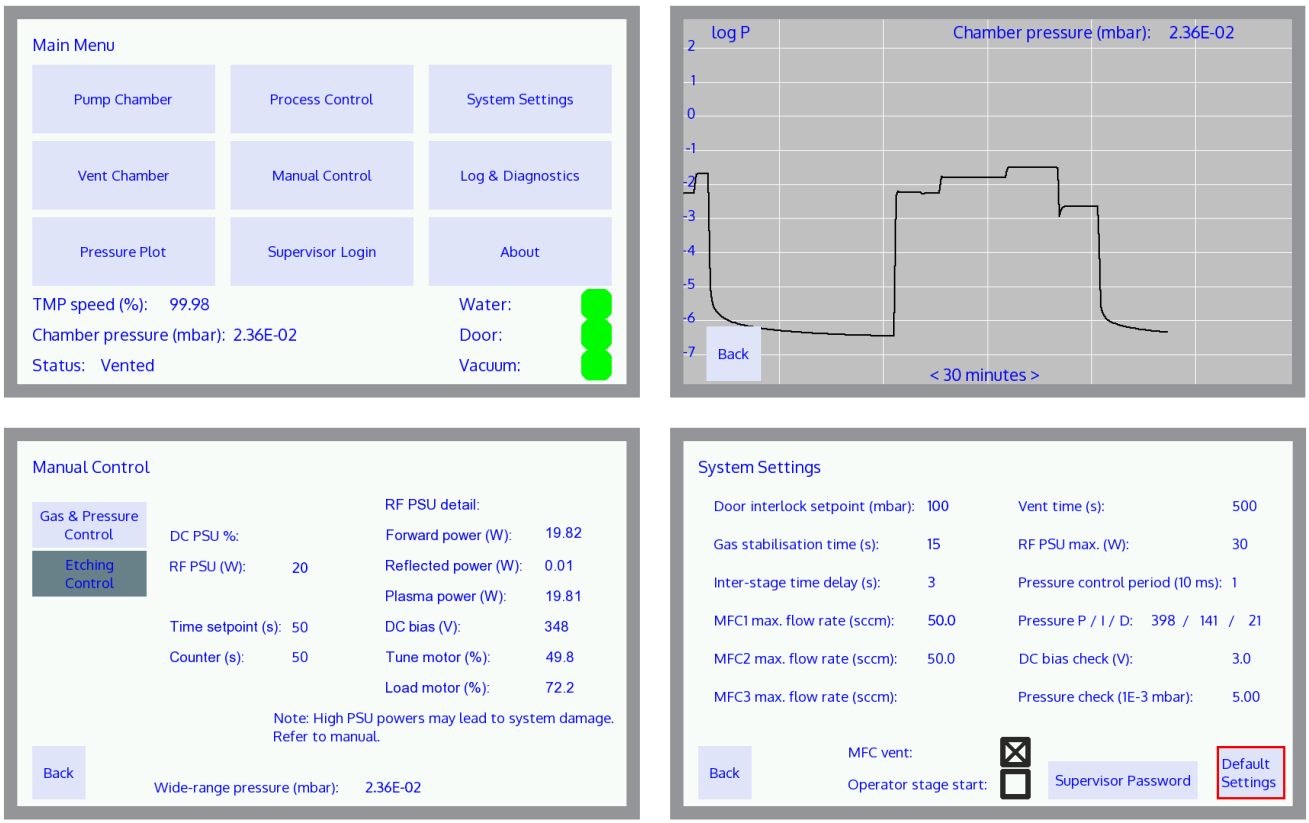
The nanoETCH system



Close-up of nanoETCH process chamber

Control system:

The unit is fitted with high-stability, industrial-grade PLC electronics. User operation is via a 7" touchscreen HMI mounted on the front panel. Powerful but easy-to-use software allows for system setup and operation via a menu-driven interface. Users are able to edit, save and load multiple recipes rapidly. Recipes and live data can be logged to a connected PC.



Screenshots from the touchscreen HMI software through which all user operation of the nanoETCH is carried out

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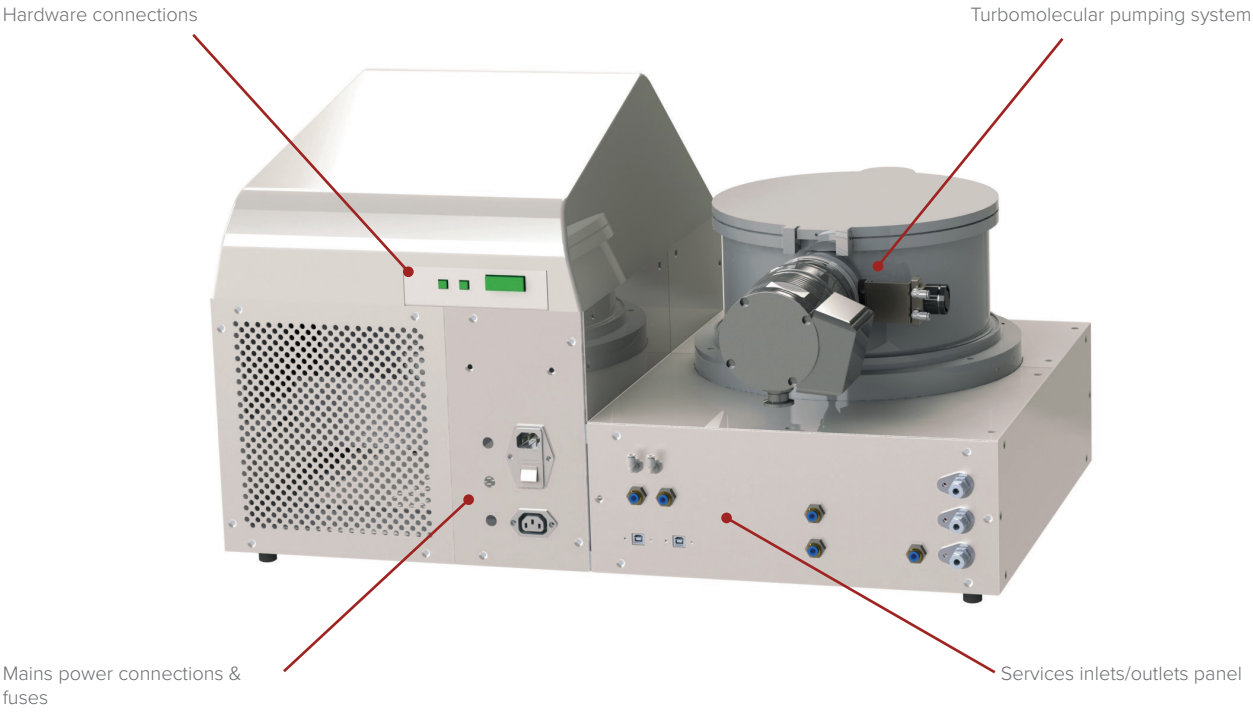
Options:

- High-accuracy pressure measurement & control
- Ultra-high resolution RF power control
- Dry backing pump
- Fast chamber vent
- Additional MFC-controlled process gas lines
- Stage sizes of 3”, 4” or 6”



System requirements: (standard configuration)

- Process gases: 25 psi supplies, 99.99% purity or better
- Service gas: Dry compressed air, nitrogen or argon. 60–80 psi supply
- Power: Single-phase 230 V, 50 Hz, 10 A
- Coolant: 18–20 °C, 1 L/min, pressure < 4 bar
- Exhaust extraction

Applications:

- Fundamental research
- Education
- Product R&D

All images/descriptions in this brochure are indicative only; final appearance and design subject to your exact configuration.

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