

General Specifications

|   |  |
|---|--|
| technology                                | ultra-low vibration, pulse-tube based closed-cycle cryostat, designed for scanning probe microscopy applications |
| sample environment                        | He exchange gas  |
| sample space                              | 49.7 mm diameter probe bore fitting all attocube inserts   |
| usability                                 | fully automated temp. and mag. field control via integrated touchscreen, web interface or LAN API                |
| vibration & acoustic noise damping system | benchmark ultra-low vibration design   |

Performance Data

|                          |  |
|--------------------------|--|
| temperature range        | 1.8 .. 300 K (automated control)       |
| base temperature         | 1.65 .. 1.8 K (for standard inserts)   |
| cool down time of sample | approx. 5 .. 8 h (depending on insert) |

Options and Upgrades

|                        |   |
|------------------------|---|
| superconducting magnet | solenoids: 9 T, 12 T, vector magnets: e.g.: 9/3 T, 9/1/1 T, ... |
|------------------------|---|

Compatibility

|                          |  |
|--------------------------|--|
| confocal microscopes     | attoCFM I, attoCFM IV, attoAFM/CFM   |
| atomic force microscopes | attoAFM I , AFM upgrade options (MFM, KPFM, PFM, conductive-tip AFM), attoAFM III, attoAFM/CFM |
| transport measurements   | atto3DR  |



attoDRY2200  
making ultra-sensitive measurements easy

# Breakthrough in ultra-low vibrations cryogenics

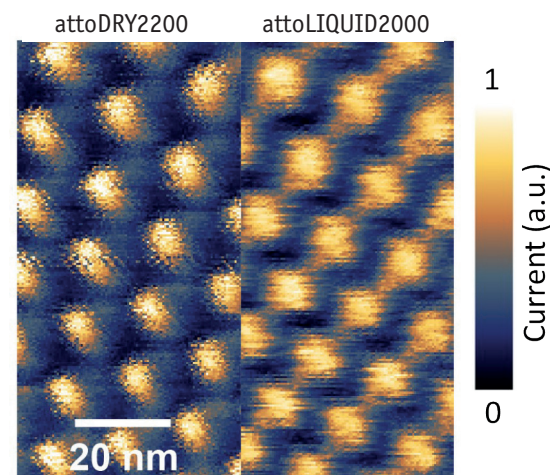
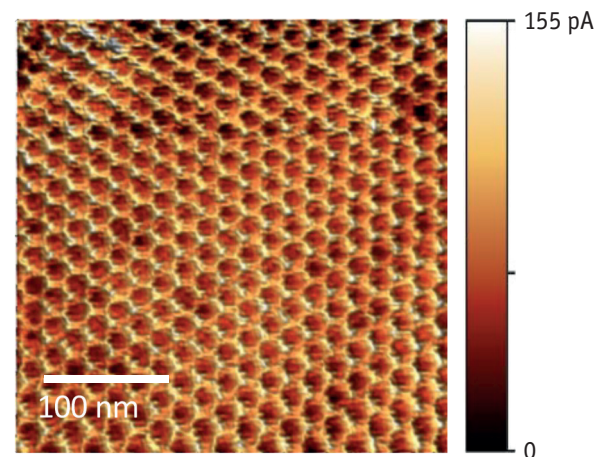
making ultra-sensitive measurements easy

## attoDRY2200

automated topleading ultra-low vibrations cryostat

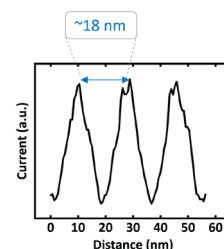
### Ultra-Sensitive Measurements from 1.8 K to 300 K (hBN/Graphene)

The attoDRY2200 is a variable temperature cryostat with maximum magnetic field being available at all temperatures. Moreover, it features ultra-low vibrations in the entire temperature range. An example thereof is a conductive-tip AFM (ct-AFM) scan of hBN/graphene bilayer at 70 K. One can see a high-resolution moiré pattern with a superlattice constant of 15 nm, and a lateral resolution of at least 7.5 nm.



### Vibrations on par with Liquid Cryostat

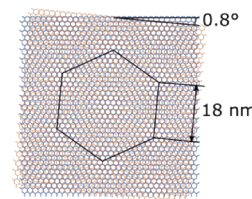
The comparison between attoDRY2200 and a liquid cryostat shows that both measurements yield the same resolution under similar measurement conditions. If anything, the ct-AFM image of tBLG shows slightly better signal-to-noise in the dry environment, confirming the excellent damping of vibrations in the attoDRY2200.



*\* Sample courtesy of Jiacheng Zhu and Kin Fai Mak (Cornell University, USA); access to attoLIQUID2000 cryostat courtesy of Istvan Kezsmarki (University of Augsburg, Germany).*

### High-Resolution Moiré Pattern of Twisted Bilayer Graphene (tBLG)

To benchmark the performance of attoDRY2200, a ct-AFM measurement on twisted bilayer graphene (tBLG) was conducted. In our sample, two graphene sheets are twisted by an angle of  $0.8^\circ$ , which yields a moiré superlattice constant of 18 nm. The measurement above clearly shows this moiré superlattice with lateral resolution at least as small as half of the distance between two superlattice nodes, i.e., in this case 9 nm.



The attoDRY2200 brings an efficiency leap in time-to-result for the most sensitive scanning probe microscopy experiments due to its ultra-low vibrations and automated control. Moreover, its suitability for various scanning probe techniques (e.g., ct-AFM, KPFM, PFM, MIM, MFM) make it the benchmark for ultra-sensitive correlative scanning probe microscopy.

- the new benchmark in ultra-low vibration
  - makes liquid cryostat obsolete even for sensitive SPM
- automated control via eNSPIRE electronics
  - web-server, live plotting & logging, versatile API
- topleading probe with free-beam access in 3D fields
  - versatile SPM platform for 2D materials research



Breakthrough in  
Ultra-Low-Vibration  
Cryogenics