

HVA150 - High Voltage Accessory for Jupiter XR AFM

The HVA150 is a high voltage accessory for the Jupiter XR large sample AFM. The HVA150 will enable advanced experiments in research fields including piezoelectric & ferroelectrics materials, 2D materials, thin films, and capacitors.

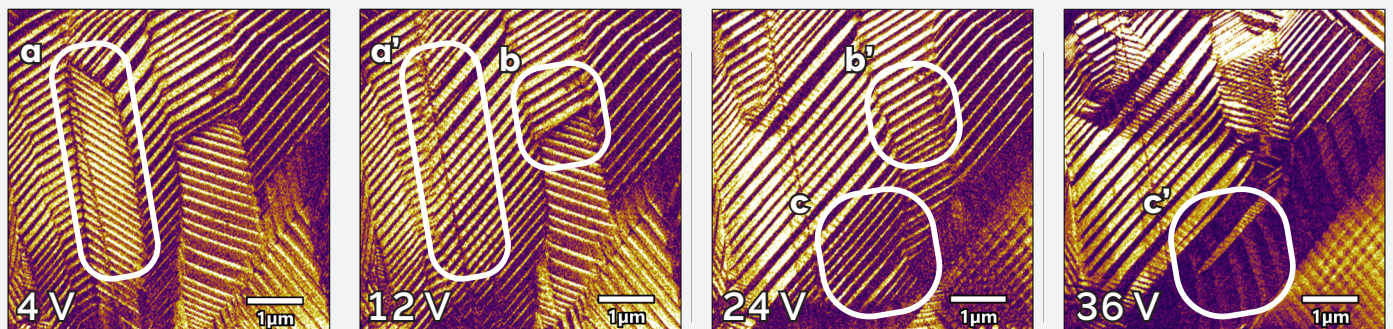
In its standard configuration, Jupiter XR allows for up to ± 10 V of bias to be applied, to either the sample or to the AFM probe. With the introduction of HVA150, the bias range is now extended up to ± 150 V.

Piezoelectric materials can be found in devices such as computer memory, sensors, actuators, and radio-frequency (RF) filters. Piezoresponse force microscopy (PFM) is an AFM imaging mode that characterizes piezoelectric and ferroelectric materials by measuring their mechanical response when electrical voltage is applied. HVA150 broadens the applicability of PFM by allowing higher probing voltages, which enable characterization of weaker piezoelectric samples and for switching the polarization of higher-coercivity materials, and other experiments where voltages of ± 10 V are just not enough.

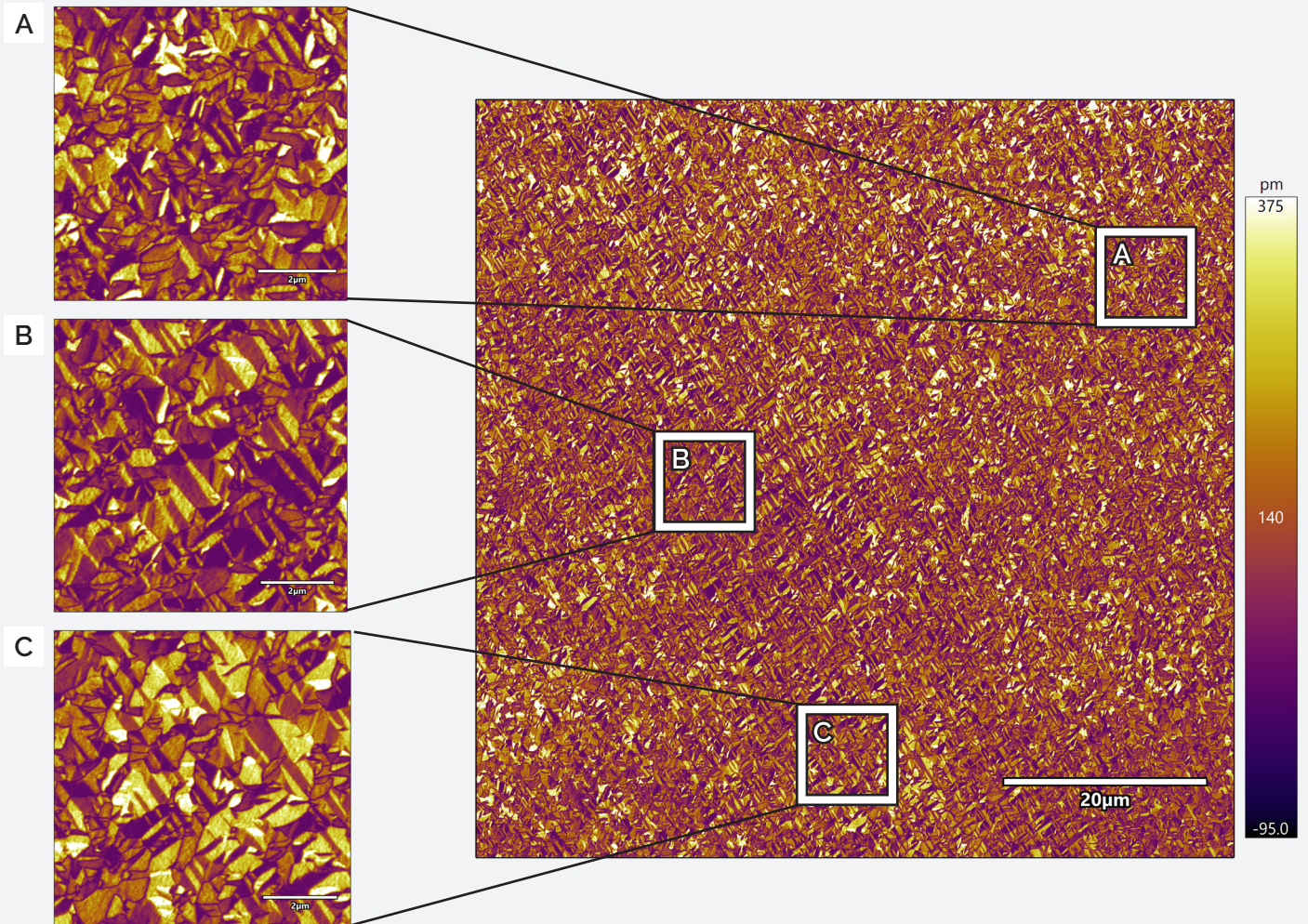


Jupiter XR AFM set up with the HVA150 accessory. All the components are automatically detected by the software for ease of setup and safety.

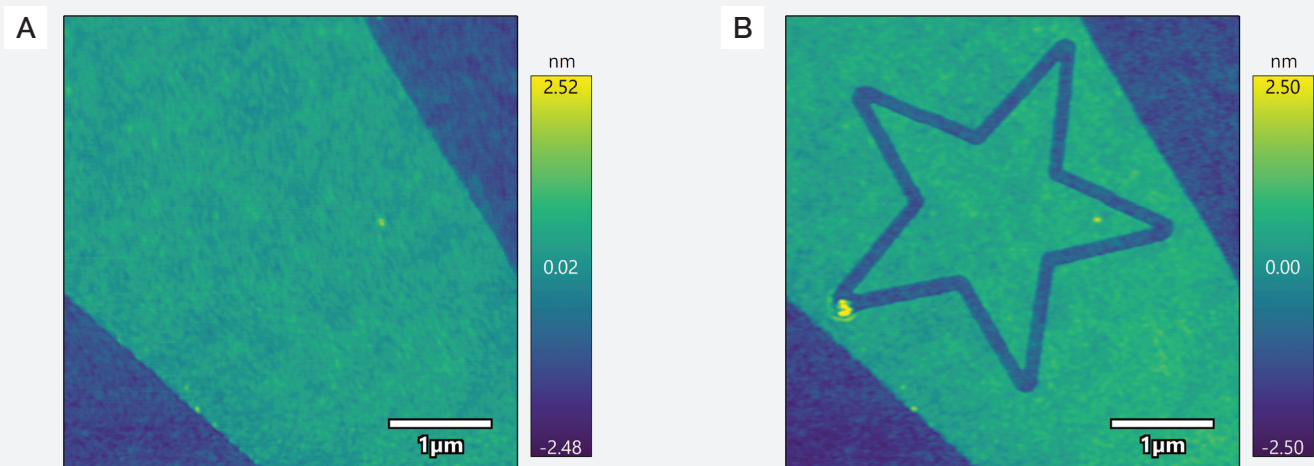
The HVA150 accessory includes an integrated high voltage amplifier, cantilever holder, sample chuck, and the necessary connections. For ease of use, all the connections are push-pull connectors, making the setup quick, easy and error proof.



Imaging of lead zirconate titanate (PZT). Series of lateral amplitude PFM images show domain growth and collapse as a function of the tip-sample bias enabled: 4 V, scale max 40 pm; 12 V, scale max 40 pm; 24 V, scale max 40 pm; 36 V, scale max 60 pm. Among the many changes in this data set, 3 areas of interest where there were significant changes in the domain structure are labeled as a-a', b-b' and c-c'. The HVA150 accessory made this experiment possible since a bias of < 10 V would have been much too small to induce changes in the ferroelectric domain structure. See the full series movie (up to 60 V) at Asylum Research website.



Large area image of PMNPT. PFM amplitude data is showing relaxor domains of the material. Image was acquired with a PtSi probe at $V_{AC} = 11.25$ V, 390 kHz. The large image size (65 μm) and the high pixel count (4096 x 4096 pixels) provides a survey scan from which high resolution digital zooms - A, B, C (8 μm) - can be produced to investigate the domain details in specific areas. This was an example where the piezoresponse from the PMNPT was small enough to require a drive voltage just a slight bit larger than 10 volts to optimize the imaging conditions.



AFM topography images of a) a few-layer graphene flake on silicon prior to cutting, and b) after cutting using a 30 V, 100 kHz AC bias on the probe tip in an environmental cell with controlled relative humidity.

The HVA150 also enhances manipulation and modification experiments of thin films and 2D materials. Oxidation- and bias-induced scanning probe lithography rely on bias being applied between the probe and the sample. The electric field generated can then be used to fabricate 10-100 nm polymer structures with high accuracy [1]. Similarly, bias applied between the probe and the sample has been

shown to create well controlled patterns (cuts) in graphene as shown in the Figure above. HVA150 offers the possibility of applying a large range of voltages to determine the perfect cutting conditions.

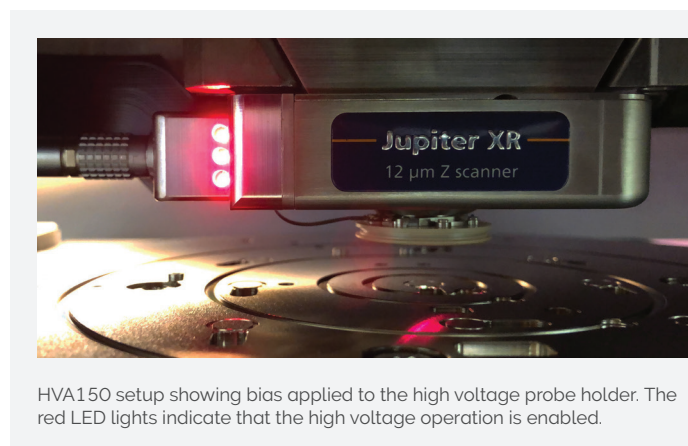
Each of the examples shown above demonstrate how the HVA150 accessory seamless integration with the Jupiter XR AFM can expand your research and provide powerful new characterization as well as sample modification capabilities.

A note about safety

The HVA150 accessory is as safe as any other Jupiter XR accessory thanks to the safety features that were incorporated into its design. When using the HVA150, redundant fail-safe interlocks are in place to prevent user exposure to high voltages. The high-voltage signal path to the tip and/or sample bias is disconnected automatically any time that the enclosure door is opened. Additionally, software prevents high voltage experiments to proceed unless all the necessary high voltage components are connected correctly.

References:

1. Ryu, Y.K., Dago, A.I., He, Y., Espinosa, F.M., López-Elvira, E., Munuera, C. and Garcia, R., 2021. Applied Surface Science, 539, p.148231.



HVA150 setup showing bias applied to the high voltage probe holder. The red LED lights indicate that the high voltage operation is enabled.

Contact Asylum Research
to find out more about
Jupiter XR large sample AFM,
HVA150 accessory and
how they can advance
your research.

AFM.oxinst.com

AFM.info@oxinst.com

+1-805-696-6466



ASYLUM RESEARCH