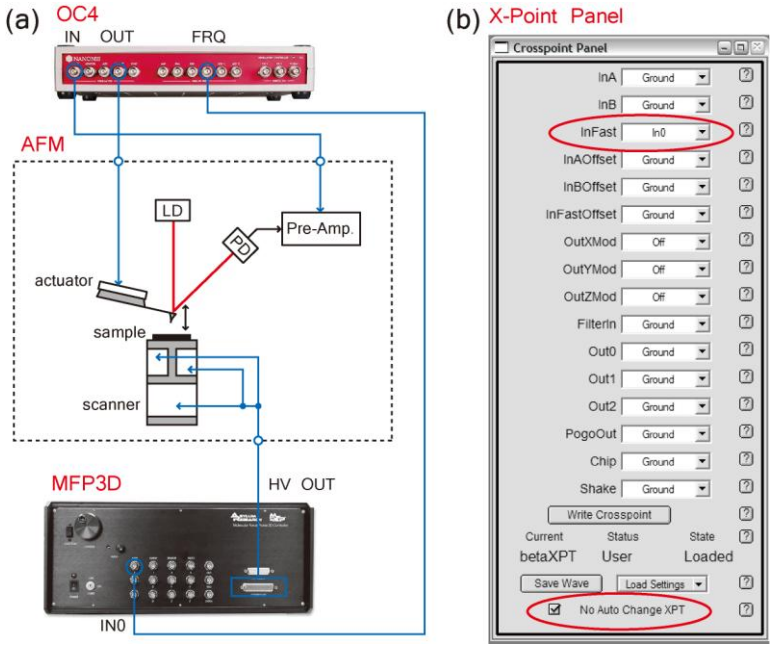
NANONIS APPLICATION NOTE

NON-CONTACT ATOMIC RESOLUTION IN LIQUID USING NANONIS OC4

AFM imaging in liquid is often challenging due to poor quality factor of the cantilever and high environmental noise. With these challenges in mind, we constructed a beam-deflection AFM designed for imaging in various environments [1, 2]. Since we wanted to operate our AFM in frequency modulation mode, we combined the Nanonis OC4 (used as a PLL) together with the Asylum MFP3D controller and were able to obtain true atomic-resolution in liquid (right image).

The schematic below shows the experimental setup. Excitation of the cantilever and frequency detection is done by the OC4. The measured frequency shift ("FRQ" output of the OC4) is fed into the "IN0" input of the MFP3D controller. By connecting "IN0" to "InFast" in the X-Point Panel and setting the imaging mode to "Contact Mode", MFP3D was configured to regulate the tip-sample distance based on the FM signal. The highly integrated design of OC4 has greatly simplified the system wiring between the devices. Its excellent noise performance has also allowed us to obtain the theoretically-limited FM noise performance even with a relatively stiff cantilever (k > 20 N/m) and small oscillation amplitude (< 0.5 nm) in liquid.



(a) Schematic of the wiring between Nanonis OC4, Asylum Research MFP3D and home-built AFM. (b) Screenshot of XPoint Panel.

Reference:

[1] T. Fukuma et al., Appl. Phys. Lett. ***92,*** *(2008) 243119.*

[2] T. Fukuma et al., Rev. Sci. Instrum. ***76****, (2005) 053704.*

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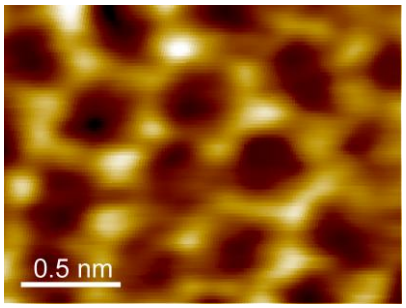

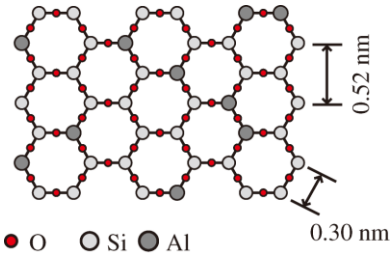

True-atomic-resolution FM-AFM image displaying honeycomb-like pattern of muscovite mica surface in phosphate buffer solution (2 nm × 1.5 nm) [1].

Nanonis Modules in Use:

- Oscillation Controller

System:

- Home-built liquid cell AFM operated using Asylum MFP3D Controller (bipolar)

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