Intermodulation on the FastScan

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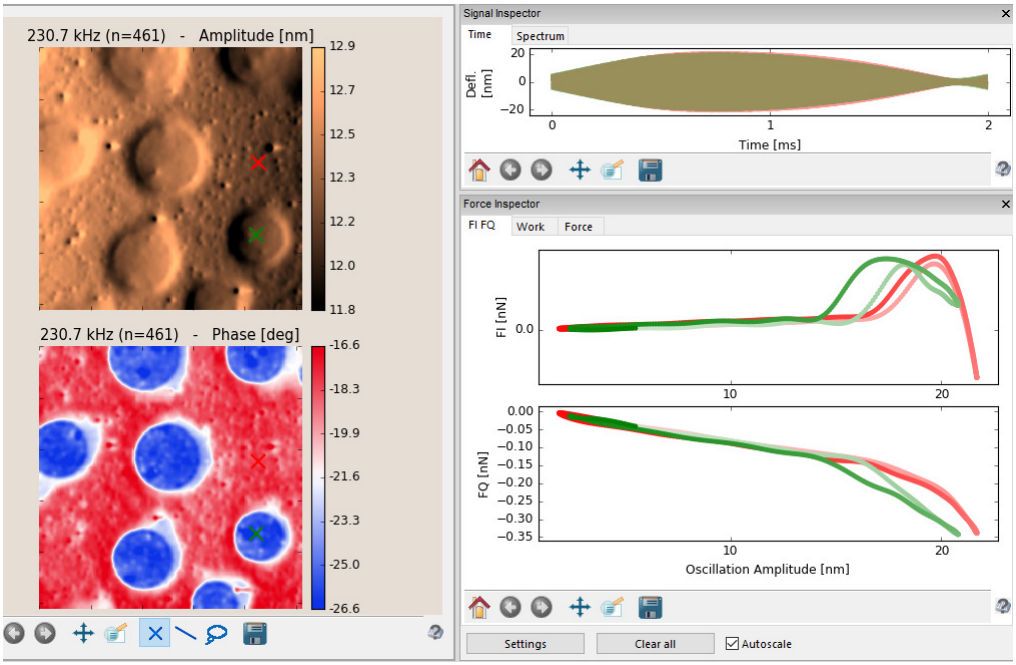

Figure 1 – successful (but not so beautiful) ImAFM measurement on Harmonix sample with a Mikromasch HQ15 probe (similar to TAP300)!

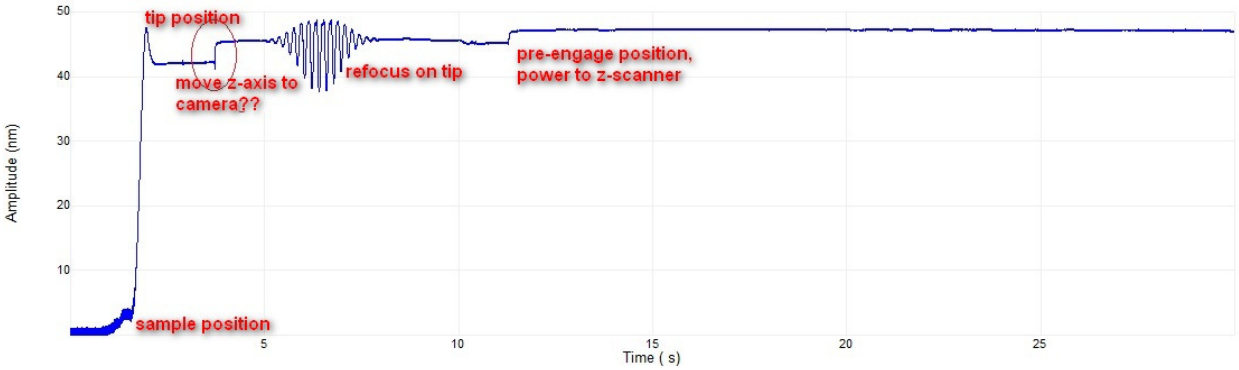

Figure 2 – Amplitude versus time for a standard tapping mode engage showing effect of different steps. The typical decrease in amplitude as the surface is approached occurred at longer times than shown here.

The FastScan has some special “features” (Figure 2) that makes it challenging to perform quantitative ImAFM measurements. In particular, the oscillation amplitude is significantly affected by application of

voltage to the scanners, moving the z-axis motor movement from the scanner position to the camera etc.

To circumvent this effect, a false engage should be performed. Use the following steps:

1) Calibrate the cantilever in the “Load Probe” window of the Nanoscope software. Switches on breakout box towards “Bruker”. Switches back to Intermodulation, exit “Load Probe”
2) Setup in Suite
3) In “Check Parameters”, set gains and scan-size to zero
4) In Engage Parameters (from Microscope menu), set General Engage>Engage Int. gain to 1 and Stage Engage>SPM Engage Step to 0.2um. Turn off “auto align photodetector” and set withdraw position to “Pre-engage”
5) FALSE ENGAGE (from Microscope menu)
6) Setup in Suite again
7) If interested, start strip recorder in Suite
8) In “Check Parameters”, set integral gain=0.3 and proportional gain=0.7 (can be optimized later)
9) ENGAGE
10) Minimize z-scanner range after engage

These steps will provide good FI and FQ curves (as in above figure). Setting gains to zero before false engage is important, as it will place the z-scanner in the middle of its range. Large deviations towards fully extended (and especially) retracted position will significantly affect the amplitude. Subsequent scanning should also be performed close to the center of the z-scan range. The best way to ensure a small variation in voltage to the z-scanner is to set a small z-range, e.g. 0.5-1.0um. A large tilt on the sample will obviously be a problem, as the tilt is compensated by the z-scanner but the voltage on it directly affects amplitude. The above image could be improved using these measures.

Note also that a low gain during engage is necessary to avoid breaking the tip. It means that engage can take a few minutes. If you have problems with tips breaking, you can also decrease the motor step-size and the scanner z-range (in the Nanoscope software). It seems that sewing is also necessary in this respect.