

Vibration analysis of a positioner (ANPz101) using the attoFPSensor



A vibrometer setup using the **attoFPSensor** has been characterized in a static vibrometry configuration (i.e. no vibration is excited). The sensitivity of the setup is shown and the striking stability of an ANPz101 is demonstrated.

The schematic of the setup is given in Fig. 1. A Si sample is placed on a Ti holder that is fixed on an ANPz101 and a piezoelectric vibrating plate. A cleaved 250 µm outer diameter optical fibre is placed in a ferrule and approached to the sample to form a cavity of a few microns size. Using the LDM1300 laser/detector module, laser light is guided into the cavity and the back-reflection from the low-finesse Fabry-Perot cavity is measured. A variation in the cavity length gives rise to a quasi-sinusoidal interference pattern in the detected sensor intensity.

Using a piezoelectric stack, the ferrule holder position can be tuned to be at the maximum of the sensor sensitivity. This corresponds to the linear part of the observed sinusoidal interference pattern. Derived from the relation given in [1], one can convert the optical signal into displacement: $\delta x = (\lambda/2\pi)\delta I/I_0$, where δx is the displacement in [nm], λ is the laser wavelength in [nm], δI is the intensity variation due to the vibration in [V] and I_0 is the overall contrast of the sinusoidal signal in [V].

A Fast Fourier Transform (FFT) of the **attoFPSensor** output signal directly allows measuring the overall system stability. The outcome of the experiments is given in Fig. 2 i) to iii). Vibrations lower as $2 \text{ \AA}/\sqrt{\text{Hz}}$ can be clearly detected between 0 and 10 kHz while the background signal is at most of only $20 \text{ pm}/\sqrt{\text{Hz}}$. For calibration purpose, the system has been excited with a fixed frequency sine-wave voltage. This gives rise to the test peaks in the results and shows the noteworthy detection sensitivity of the setup.

In these measurements, few of the impressive capabilities of the **attoFPSensor** have been explored (here in a bare-fiber, static vibrometer setup). The setup comprising an attocube ANPz101 positioner proves to have better stability than $2 \text{ \AA}/\sqrt{\text{Hz}}$ between 0 and 10 kHz.

These measurements were performed by K. Karrai and P.-F. Braun in the attocube application labs.

[1] D. Rugar, et al., Appl. Phys. Lett. 55, 2588 (1989)

RELATED PRODUCTS

attoFPSensor	attocube fiber probe sensor in vibrometry configuration
ANPz101	linear, vertical stepper positioner
LDM1300	laser detector module for 1310 nm

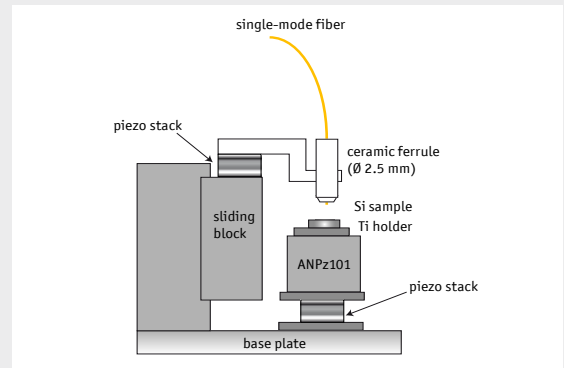


Fig. 1: Schematic of the measurement setup.

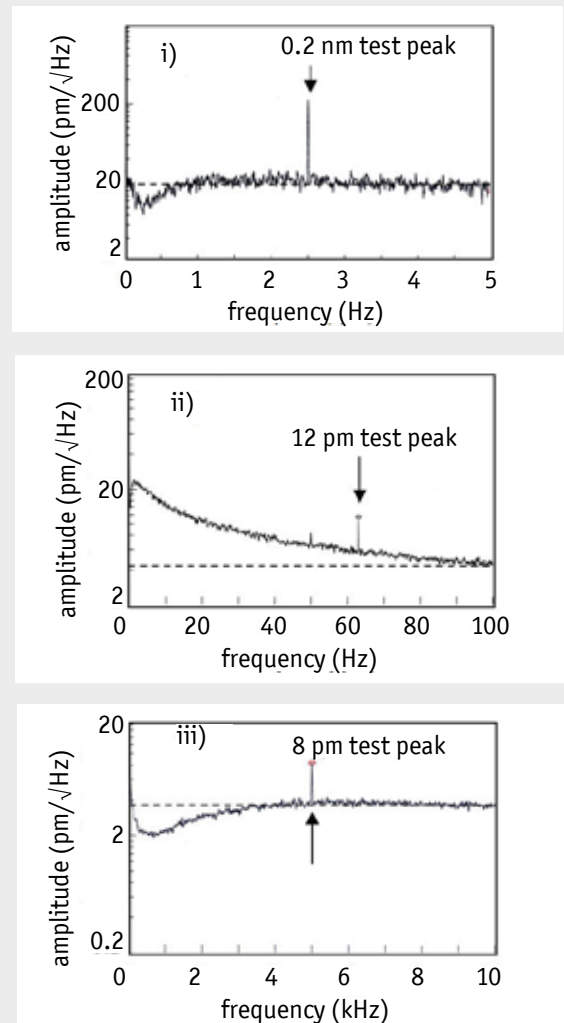


Fig. 2: Vibration as a function of frequency in the vibrometer setup. i) very low frequency range up to 5 Hz, ii) low frequency range up to 100 Hz, iii) frequency range up to 10 kHz.