

# Single point vibration measurement

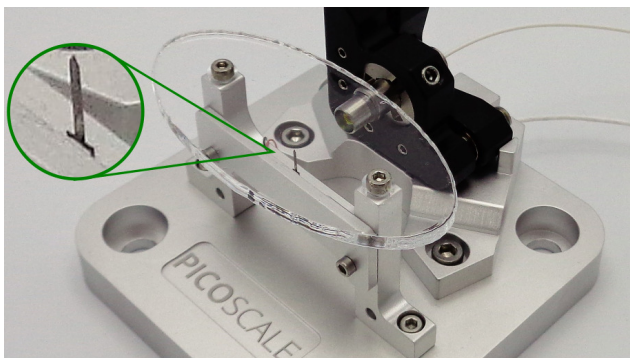
## INTRODUCTION

SmarAct's **PICOSCALE** is a contact-free displacement sensor with sub-atomic resolution based on a laser interferometer. The fast data processing allows for high bandwidth vibration measurements. In this application note, the vibrations of a small cantilever are analyzed.

The results show that the **PICOSCALE** can be used for single point vibration analysis. The low noise floor and high resolution allows to study mechanical properties of samples in fundamental RnD. At the same time, the high dynamic range allow to track macroscopic motions and vibrations, qualifying the system for industrial applications and process control at larger scales.

## SETUP

The setup used for this application note is shown in Figure 1.



**Figure 1.** Experimental setup. The **PICOSCALE** probe beam is focused to a tungsten cantilever with a PS-SH-F01-10 sensor head.

A F01-10 sensor head (focusing sensor head with working distance 10 mm and spot size of about 30  $\mu\text{m}$ ) is aligned to a cantilever. The cantilever is glued to a piezo stack to eventually excite vibration modes.

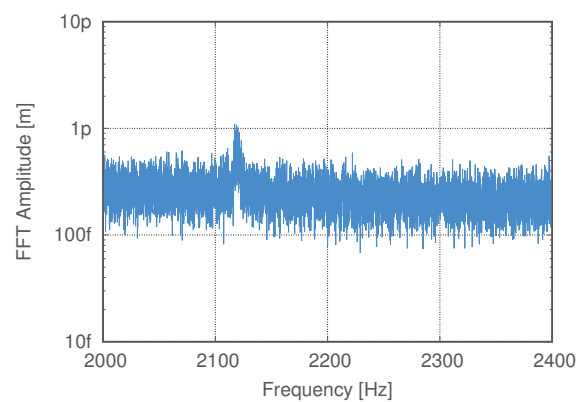
Even though many cantilevers are made from silicon, which have low reflectivity at infrared wavelengths, the **PICOSCALE** can be used to measure the displacement. As the measurement beam is focused, this confocal configuration suppresses stray light from other surfaces and only a single surface is analyzed. (This smart concept is employed in the **PICOSCALE Vibrometer**, a turn-key solution for full modal analyses of small samples.)

## RESULTS

The recorded position data can directly be analyzed using the Fast-Fourier-Transform (FFT) functions of the **PICOSCALE** graphical user interface.

### Thermal spectrum

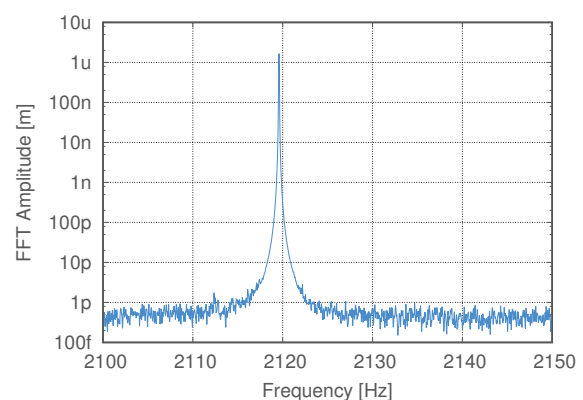
First, the cantilever is not excited, but a very small peak around 2100 Hz appears, see Figure 2. This peak indicates a mechanical resonance, only excited by surrounding noise or thermal excitations.



**Figure 2.** Thermal spectrum of the cantilever with a small peak around 2120 Hz.

### Excitation

In the next step, the cantilever's eigenfrequency at 2119 Hz was excited with the piezo, which is driven by the **PICOSCALE Breakout Box**. The resonance peak becomes very pronounced.



**Figure 3.** Resonance peak that is excited with the piezo stack below the cantilever.

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SmarAct Metrology GmbH & Co. KG develops sophisticated equipment to serve high accuracy positioning and metrology applications in research and industry within fields such as optics, semiconductors and life sciences. Our broad product portfolio – from miniaturized interferometers and optical encoders for displacement measurements to powerful electrical nanoprobers for the characterization of smallest semiconductor technology nodes – is completed by turnkey scanning microscopes which can be used in vacuum, cryogenic or other harsh environments.

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