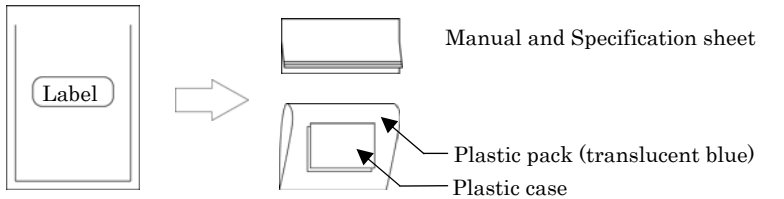
Micro cantilever Instruction manual

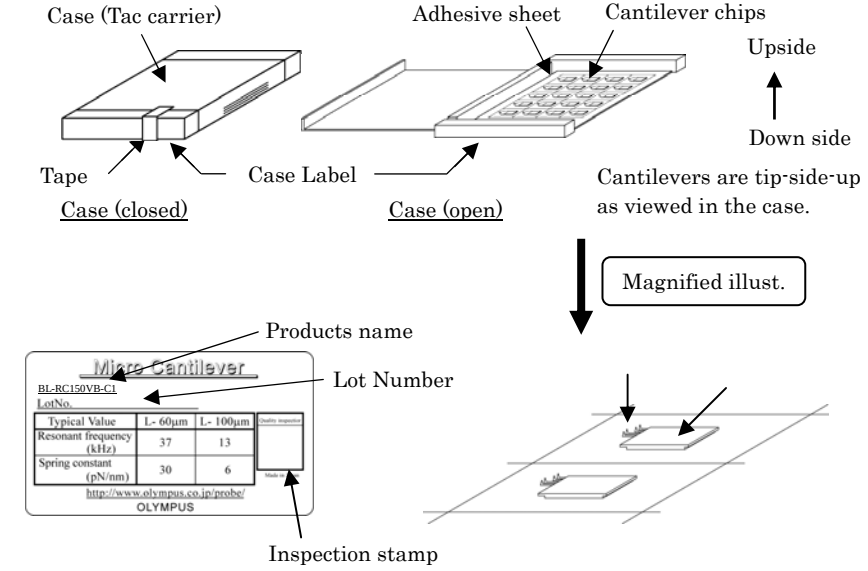
Thank you for purchasing OLYMPUS Micro cantilever.
Please read this manual carefully before use.

＜Explanation of packing＞

Cantilever chips in a plastic case are included in the envelope with manual and spec. sheet.



Cantilever chips are contained in the plastic case (Tac carrier)



OLYMPUS

Please obey the following when use OLYMPUS micro cantilevers.

⚠ Warning

- Use protective eyewear when handling to avoid damage to the eyes from breakage of the cantilever chips

⚠ Caution

- Please handle our cantilevers carefully because they are fragile.

⚠ Caution

- Do not drop or shake the cantilever case. Even when the cantilever chips are contained in the cantilever case, the cantilevers may break if the case is handled roughly or jarred.

⚠ Caution

- It is recommended that precautions be taken to prevent damage to the cantilever tips from electrostatic discharge.

⚠ Caution

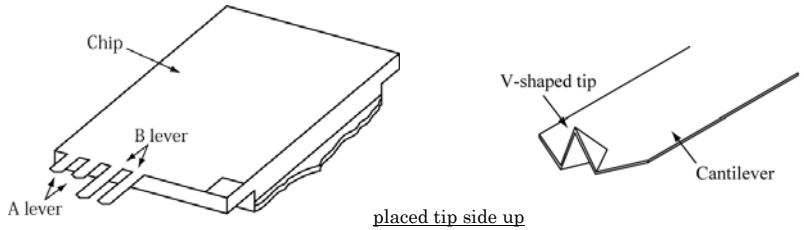
- Be sure to store the cantilevers at room temperature and moderate humidity.

⚠ Caution

- When discarding, please obey the laws and regulations in your country and/or your company. These cantilevers are made from silicon nitride and gold.

Special feature of OLYMPUS Micro cantilever
(Bio-Lever : BL-RC150VB-C1)

1. Two types of cantilevers
   There are two types of cantilevers, the short cantilever (A Lever) and the long cantilever (B Lever) on one side of the glass chip.
2. Gold on both side of cantilever
   The tip side of the cantilever is coated with gold as well as the backside. This makes functionalizing the cantilever tip easier (e.g. using thiol chemistry.)
   The gold coating at the tip side is 20 nm thick while that at the backside is 30 nm thick.
3. Tip View
   The tip is fabricated on the exact end of each cantilever. Since the tip isn't hidden by the body of cantilever, it can be positioned exactly at a point of interest using optical microscopy.
4. V-shaped Tip
   The radius of the curvature of the tip is 40 nm or less. (30 nm typ.)
   The OLYMPUS V-shaped tip is unique. Geometrically, it is a hollow pyramid sliced in half vertically with a sharpened apex (See the figure below). The tip height is greater than 5 μm high to help prevent the body of the cantilever from touching a specimen.
5. Pre-separated Chips
   Offered in Tac carrier case, the chips are individually separated and packed in advance. The chips can be used in an AFM as soon as the case is opened.



placed tip side up

Table of contents

1 Preparation

1) Please prepare the following items before using OLYMPUS cantilevers.
2) To gain a better understanding of how cantilevers and chips are connected, it is very useful to view them using a stereo microscope.

1) Work environment	: Clean bench (Use of an electrical charge neutralizer or ionizer is recommended.)
2) For hazard avoidance	: Protective eyewear
3) For cantilever treatment	: Tweezers (Use of anti-electrostatic discharge mat and a wrist band is recommended.)
4) For inspection	: Stereo microscope

2 Open the case

⚠ Caution

- Please handle our cantilevers carefully because they are fragile.

⚠ Caution

- It is recommended that precautions be taken to prevent damage to the cantilever tips from electrostatic discharge.

1) It is recommended that the cantilever case be opened in a clean environment like a clean bench in order to avoid the cantilever being contaminated. Handling under an ionizer is recommended.
2) Avoid wearing clothes like woolen sweaters, fleece, etc that give off the static electricity when handling the cantilever cases and chips. Use of an anti-electrostatic mat and wrist band is preferable.
3) In opening the case, put the plastic case label-side down on a desk.
   The cantilevers are tip-side-up as viewed in the case.
4) Open the case

3 Picking up the cantilever chip from the case

⚠ Caution

- Avoid any contact with the cantilevers when you pull up the cantilever tip from the case.

1) Pick up the chip by the long side with the tweezers and mount it in the AFM.

4 Trouble-shooting Guide

Situations like the ones described below may occur when using Bio-Levers. Often, the problems occur because the Bio-Levers have a much smaller spring constant than standard cantilevers.

Case1: Extreme bending of the cantilevers when used in air.
When the specimen or sample holder is electrostatically charged in air, the cantilever is attracted to or repelled from the sample because of electrostatic forces. Often, the photo detector can not be adjusted to zero the deflection signal or maximize the total reflected light of the optical beam deflection sensor.

Solution:
Eliminate the static electricity around a specimen and the cantilever. Using a charge neutralizer often helps.

Case2: Bending of the cantilever at the air-water interface
When approaching a wet sample specimen (with the cantilevers still dry), the cantilevers may be sucked into the water by the surface tension at the interface. Sometimes, the cantilever can be bent down 90 degrees to the substrate making it impossible to get any reflected laser light.

Solution:
Before approaching the cantilever toward the specimen, wet both the specimen AND the cantilever. Using a syringe, gently apply a drop of water to the cantilever holder from the side of the cantilever chip. This way the air-water interface approaches the cantilever sideways and the cantilever is less likely to bend. Detergent may also be helpful to reduce the surface tension.

Case3: The cantilevers act as a microphone
Because the cantilevers have such small spring constants and low resonant frequencies, they can be very microphonic. This is especially true in water where the resonant frequency is only a few kilo Hertz.

Solution:
Try to make the measurement environment as acoustically quiet as possible. Make sure any devices with fans (air conditioning often causes problems) that aren't necessary are powered off. The AFM can also be enclosed in an acoustic hood to reject external noise.

5 Scope of the Specification

The following situations are not regarded as defects.

1) One of the two pairs of cantilevers is incomplete. (e.g. a chip has two A Levers, but only one B Lever.)

Spec:
The glass chip is in accordance with the specifications as long as a single pair of A Lever and B Lever is completed.

2) The results of actual measurements of spring constant and resonant frequency differ from those listed in the specification sheet of OLYMPUS micro cantilevers at the end of this manual.

Spec:
In the specification sheet the typical values calculated at the design process are listed. Those values may differ slightly from the actual measured values.

3) Four cantilevers are not positioned in the center of the glass chip.

Spec:
The short cantilever (A Lever) is aligned close to an edge of the cantilever chip in accordance with the specifications. This is to prevent the shoulder of the cantilever chip from touching a specimen before the cantilever tip when approaching the cantilever toward a specimen for measurement.

4) The cantilever becomes too bent to use after a long-term storage.

Spec:
Though the cantilever is generally stable for a year after production, the cantilever may degrade in quality depending on the condition in which the cantilever is stored.
Additionally, Bio-Levers are not guaranteed to work in all AFMs since their tolerances for the allowable bending of the cantilever are different. It is recommended to use the cantilever within 6 months.

6 Appendix 1. Force curve measurement

Though the instruction manual of your AFM should give a basic description of the force curve measurement, this section also describes the general procedure of the force curve measurement.

1. Preparation

Prepare a glass slide for sensitivity calibration of the optical deflection sensor and mount it on the sample holder of the AFM instrument.
Mount the cantilever to the cantilever holder and attach to the AFM instrument.

Align the laser spot from the optical deflection sensor onto the backside of the cantilever as close to the apex as possible. If too much scattered light is observed through an optical microscope, the laser spot may be hitting the edge of the cantilever. Move the laser spot onto flat surface on the cantilever to reduce the scattered light.

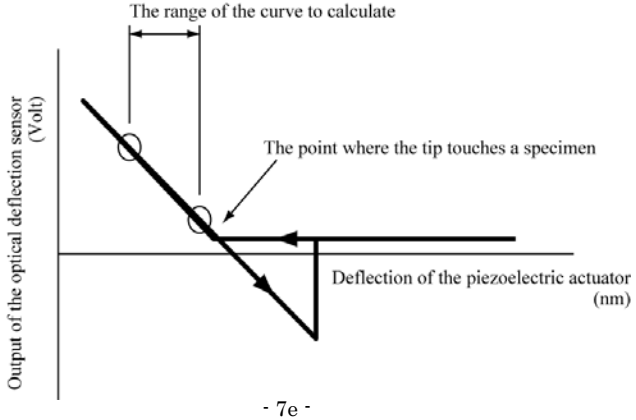
2. Calibrate the sensitivity of the optical deflection sensor

Each time you mount a new cantilever in the AFM, be sure to calibrate the sensitivity of the optical deflection sensor. The sensitivity differs depending on the combination of the cantilever and the optical deflection sensor. The sensitivity is a measure of how many volts the photo detector reports for given cantilever deflection.

Even using the same cantilever, you should calibrate this sensitivity again any time you adjust the position of the laser spot on the cantilever. This is because the sensitivity depends on where the spot is. It is highest at the free end.

Adjust your instrument so that you are doing repetitive force curves over such a Z range that the curves include both the contact (diagonal line) and non-contact (flat line) regions (see figure).

Calculate the slope of the diagonal line by dividing the voltage difference along a portion of the line by the distance traveled by the Z actuator along the same portion (see the figure). The inverse of this number gives you the sensitivity of the optical deflection sensor (nm/Volt).



3. Measure the spring constant of the cantilever

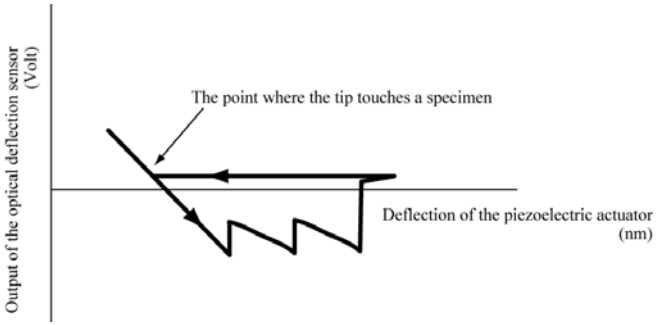
Actually measuring the spring constant of the cantilever. (pN/mm)
The spring constant shows the same value whether it is measured in air or in water. Generally, measurements in air are easier.

For measuring the spring constant of the cantilever, refer to the instruction manual of your AFM instrument.

The measurement method referred to as Thermal method is often employed to measure the small spring constant of a soft cantilever like Bio-Lever.
Note that the spring constant can not be measured if your AFM instrument does not show the peak of resonant frequency, even though it has the measurement program employing Thermal method.

4. Measure the force curve

Replace the glass slide for sensitivity calibration of the optical deflection sensor for a specimen to measure.



7 Information

Please contact following if you have any question on this user's manual.

OLYMPUS CORPORATION
Microtechnology R&D Division
2-3 Kuboyama-cho Hachioji-shi Tokyo 192-8512 Japan

email : probe@olympus.co.jp

Please access to the web page of OLYMPUS micro cantilevers.

http://www.olympus.co.jp/probe

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OLYMPUS CORPORATION