

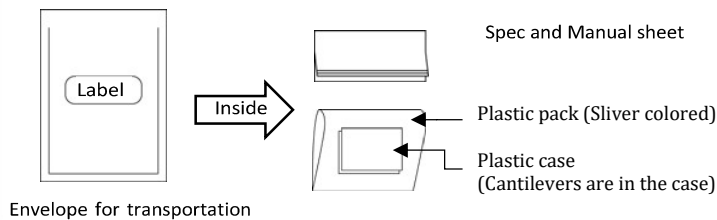
Pyramid Micro Cantilever User's manual



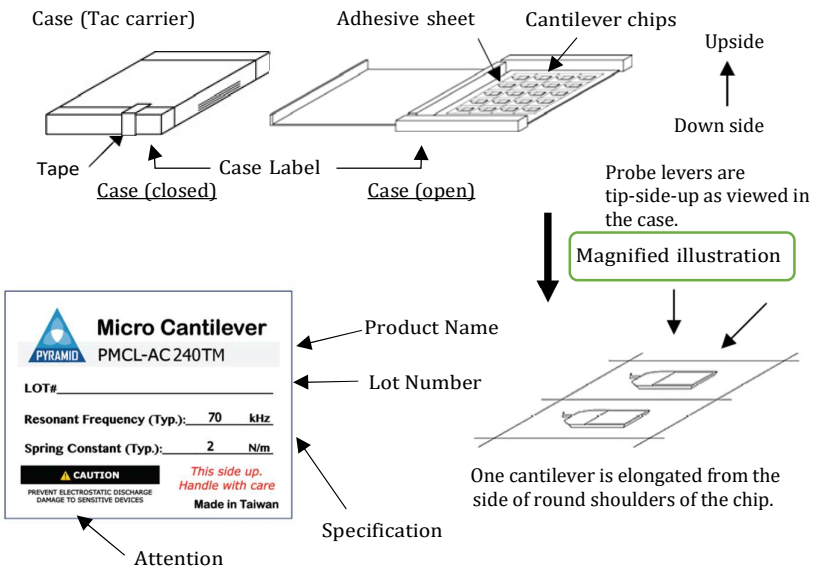
Thanks for purchasing **Pyramid PMCL-AC240TM** Micro Cantilever. Please read this manual carefully before use.

< Explanation of the each part of the products >

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)



Please obey the followings to Pyramid Micro Cantilever

Warning

! Use protective eye glasses when handling to avoid damage to the eyes from breakage of cantilever chips.



Attention

! Please handle cantilever carefully because they are fragile.

Attention

! 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.

Attention

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

Attention

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

Special feature of Pyramid Micro cantilever

(PMCL-AC240TM)

1. Platinum coated silicon cantilever – This probe chip is designed for electrical probing SPM techniques such as EFM, KFM and SCM.
Platinum is employed as the coating material which is a precious metal maintains the good conductivity for a long time.
 2. Pre-separated chip – Each probe chips is isolated in the case.
The chips can be attached to the AFM instrument as soon as the case is open.
 3. Tip view – The tip is located on the very end of the AFM probe lever.
This feature allows you to set the tip over a point of interest on the sample, easily and precisely, if you use an AFM combined with an optical microscope.
 4. Sharp tip – The tip radius is typically 20nm.
The tip shape follows the shape of the basic silicon probe. The tetrahedral shape of basic silicon tip is ideal for achieving a point terminated tip.
 5. Reflex coating probe lever – Aluminum is coated onto the back side of the probe levers for optical deflection sensing.
Good S/N signal can be expected in the optical sensor circuit
 6. Compatible chip – The thickness of the chip (substrate) is 0.3mm. This type of the chip can be attached to most of AFM instruments.
- See the specification sheet of Silicon AFM PROBE from Information session of this manual.

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1. Preparation

1. Please prepare the followings before using Pyramid cantilevers.
2. To gain a better understanding of how cantilevers and chips are connected, cantilevers should be inspected under the microscope.
 - i. Work environment : Clean bench
(Use of an electrical charge neutralizer or ionizer is recommended.)
 - ii. For hazard avoidance : Protective eye glasses
 - iii. For cantilever treatment : Tweezers
(Use of anti-electrostatic discharge mat and a wrist band is recommended.)
 - iv. For inspection : Stereo microscope

2. Open the case

Attention

- ! Please handle the chips carefully because they are fragile
- ! It is recommended that precautions be taken to prevent damage to the probe tips from electrostatic discharge

1. It is recommended that the cantilever 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 chip 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

Attention

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

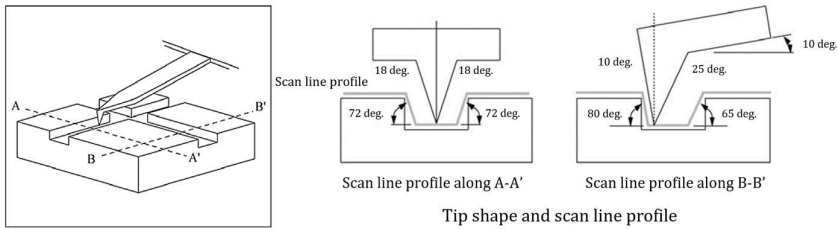
1. Pick up the chip by the long side with the tweezers and mount it in the AFM.

4. Tip shape of Tetrahedral tip

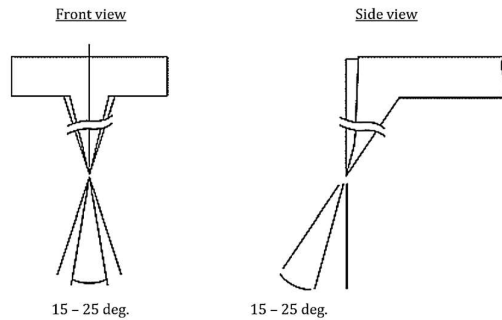
As can be seen in the bottom left illustration, a tetrahedral tip is located at the exact end of the cantilever.

The finite tip shape will determine the scan line profile as in the illustrations below. The tip profile is symmetric with a half tip angle of 18 degrees macroscopically (see the middle below).

The side tip profile is asymmetric with a tip angle of 35 degrees. Then the cantilever chip is attached to a chip holder in your AFM tool with an angle, about 10 degrees, the asymmetry is improved (see right below).

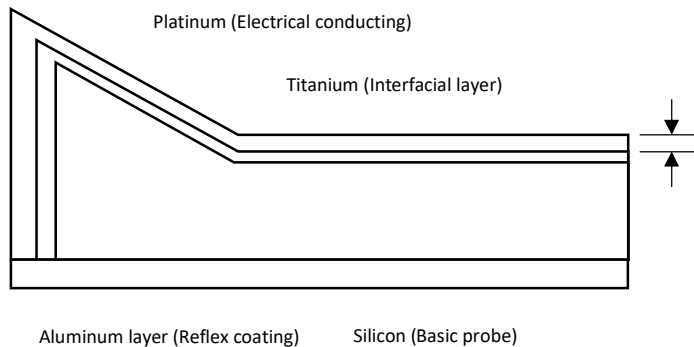


The apex of the tetrahedral tip becomes sharper due to an oxide sharpening process. The tip angle around a few hundred nano meter down from the apex, is about 15 to 25 degrees (see below).

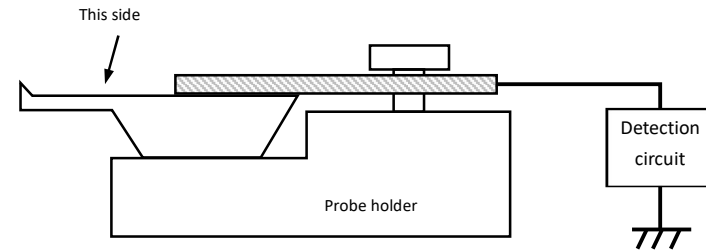


Sharpening effect around tip apex

5. Platinum coating



As can be seen in the illustration, the platinum layer is deposited on the basic silicon probe with titanium interfacial layer.



In attach the chip to your SPM instrument, electrically connect to the chip in the cantilever side for stable measurements (as the illustration). It is not expected that the aluminum layer shows good conductivity because the surface of the aluminum layer is covered with oxide layer.

6. Trouble-shooting Guide

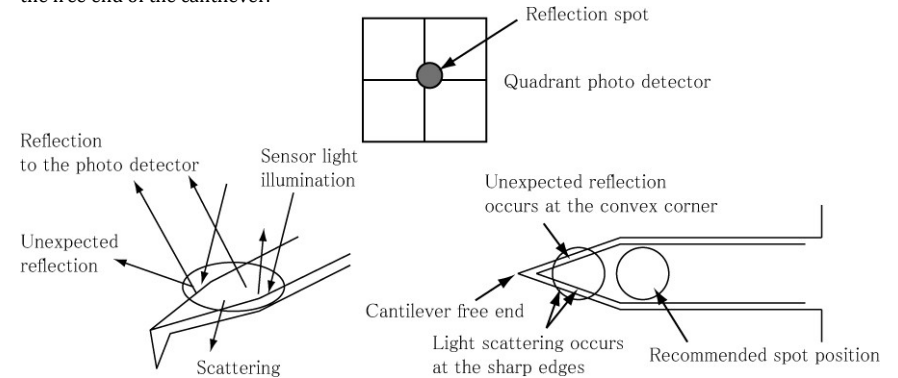
Situations as described below may arise when using this type of cantilever.

Case1:

In adjusting the sensor optics before scanning, the movement of the reflection spot on the photo detector is critical so that the sensor optics is hard to adjust to zero position. When the sensor illumination spot on the cantilever is not small enough and is positioned at the triangular part of the cantilever, unexpected reflection and light scattering occur. This may cause the unexpected movement of the reflection spot on the photo detector.

Solution:

Try to adjust the focus of the sensor optics again and move the spot position a little opposite to the free end of the cantilever.



Case2:

The electric images turn to vague and low in contrast after several scans in EFM. Even in AC mode operations as EFM, the probe touches the sample surface and the platinum coating may wear.

Solution:

Once platinum layer has worn extremely, the cantilever should be replaced. Since this case is found frequently, look the servo condition of your SPM again.

Case3:

The electric images of an IC device turn to high contrast after the several scans in SCM. The worn of the platinum coating is suspected. In SCM of IC devices, the signal is depending on the density of the dopant. Blunt probe may interact with more dopants and get higher electric signals.

Solution:

In the case that the platinum layer has worn extremely, even if higher signal is obtained, it is recommended that the cantilever is replaced. Please check the lateral resolution of the image as well as the signal contrast. Those are trade-off.

7. Scope of specification

Actual resistivity of the probe

Spec: The actual resistivity of the probe is not guaranteed.

Note: In our process, we test 5 points of monitor wafer, with resistivity approximately 100

Ohms, which meets the specification of less than 150 Ohms.

8. Information

Please contact us in the following information if you have any question on this user's manual.

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