

# HOPG\*



ACCESSORIES

Mikromasch is happy to inform our customers that we are able to offer for STM/SPM application samples of increased quality that are cut from the inner part of the annealed volume.

More information at [www.spmtips.com](http://www.spmtips.com)

## MORE POSSIBILITIES

### WIDER CHOICE OF MOSAIC SPREADS

We now offer 0.4, 0.8, 1.5 and 3.5 degrees mosaic spreads! The lowest mosaic spread samples are  $0.4^\circ \pm 0.1^\circ$ , which have the best quality achieved for bulk commercial HOPG. These samples have a minimal amount of defects and a particularly smooth surface. Thin layers down to 10  $\mu\text{m}$  can be cleaved off and up to 100 cleavings of a 2 mm sample are possible.

### DOUBLE-SIDED SAMPLES

Samples cut from the center of the annealed volume of HOPG that have the same mosaic spread throughout the sample are called double-sided. To confirm the grade, the mosaic spread is measured on both sides of the sample. In such samples there is no degradation of quality through the sample, thus the quality of the freshly cleaved surface remains identical during the thinning of the sample. The thickness of a cleaved layer does not increase with the number of cleavings, so one can refresh the surface more times than with single-sided samples.

## BEST QUALITY

### HONEST QUALITY

Mosaic spread is measured by the standard method. Measurements are carried out with  $\text{CuK}\alpha$  radiation and the beam illuminating a significant part of the crystal simultaneously (approximately 8 x 8 mm taking into account the incident angle). This is important because the measured value of the mosaic spread depends not only on crystal quality, but also on the energy and the cross section of the reflected beam. This effect is caused mainly by large-scale surface inplanarity or large-scale inplanarity of the carbon layers. Small regions tested by a narrow beam could have additional mutual mismatch that increases the measured value of mosaic spread when the crystal is illuminated by a wide beam covering both regions simultaneously. In a similar way the large-scale mismatch between outer layers and deeper layers that start to involve reflection could increase the value of mosaicity measured with harder X-rays or with neutrons which have a larger penetration depth than  $\text{CuK}\alpha$  radiation.

### CONSISTENT QUALITY

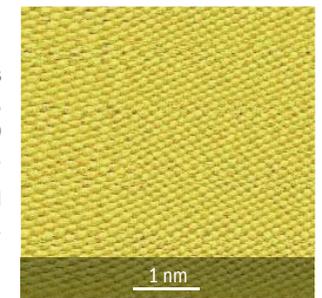
Our double-sided samples guarantee that the surface quality remains unchanged after multiple cleavings.

### LONG-LASTING

Our samples are annealed at a higher temperature that results in larger crystallites and grains and a smaller number of defects binding the neighboring carbon planes. Therefore thinner layers can be cleaved off and more cleavings are possible.

One of the first images of graphite atomic structure, obtained on Femto Scan microscopes.

Courtesy by Advanced Technologies Center.



# FAQ

## Can HOPG be used for calibration of X-Ray equipment?

Because the quality is determined by precise X-ray measurements, our HOPG can be used not only as SPM/STM substrates, but also as crystal-monochromators for X-rays and neutrons. Crystal-monochromators for X-rays and SPM/STM substrates are made with the same technology. We offer different sizes and qualities which correspond to grades for X-ray and STM requirements. (Nevertheless, it is important to inform us in advance that certain samples are going to be used as monochromators – we will choose crystals for X-ray and especially for neutron applications with better planarity from a batch).

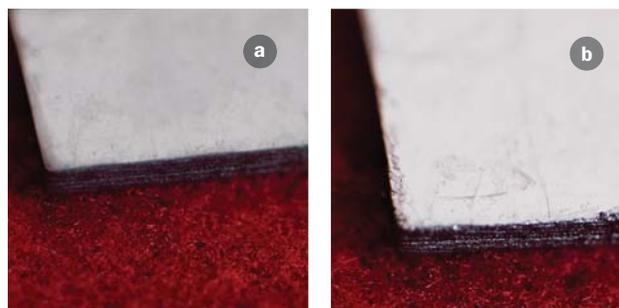
## Why would I need SINGLE-SIDED SAMPLES?

In single-sided samples there is some degradation of the grade and correspondingly an increase in defects away from the working side. It leads to a smaller number of cleavings compared to double-sided samples. However, such samples exhibit a favorable “number of cleavings /price” ratio for many applications.

## My sample has a bad APPEARANCE. How will it influence my work?

HOPG samples annealed at lower temperatures or cut from the edge of the plate are harder (a) and may have a nice appearance, but this is actually due to an increased number of defects between the layers and smaller grain sizes (resulting in a reduced ability to cleave), which means they have little value as AFM/STM substrates.

Samples that are useful for STM/AFM are soft (b) and can acquire uneven “flaky” edges during cutting. Imagine cutting a large bundle of paper: thin sheets and weak bindings between them prevent a neat accurate cut. Thus, in this case a bad appearance is actually an unavoidable result of the high quality of the sample.



Side-view photographs of hard (left) and soft (right) HOPG samples. The soft sample has uneven edges due to the explicit lamellar structure which just makes it applicable for STM/AFM experiments.

Courtesy by MikroMasch.

# SPECIFICATION

Name	Type	Qty	Price
HOPG mosaic spread <b>3.5 ±0.5</b>	ZYH + DS/1 mm		€ 240
	ZYH + DS/1.75 mm	5ps	€ 330
	ZYH + DS/2 mm		€ 360
HOPG mosaic spread <b>1.5 ±0.3</b>	ZYD + SS/1 mm		€ 144
	ZYD + SS/1.5 mm		€ 180
	ZYD + SS/2 mm	3ps	€ 216
	ZYD + DS/1 mm		€ 276
	ZYD + DS/2 mm		€ 420
HOPG mosaic spread <b>0.8 ±0.2</b>	ZYB + SS/1.5 mm		€ 100
	ZYB + DS/1 mm	1ps	€ 120
	ZYB + DS/2 mm		€ 240
HOPG mosaic spread <b>0.4 ±0.1</b>	ZYA + DS/1 mm	1ps	€ 468
	ZYA + DS/2 mm		€ 700

**WE OFFER BETTER SUBSTRATES  
FOR LESS MONEY**

