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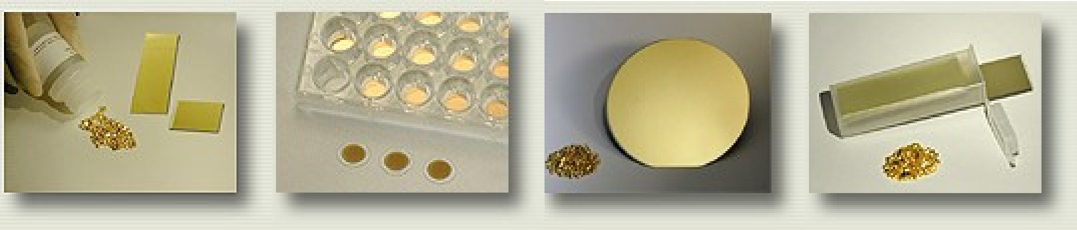
# GOLD-COATED SUBSTRATES



**Gold-coated glass slides / mica / silicon wafers / coverslips**

**Our gold-coated substrates offer valuable features that will enable you to:**

- Avoid paying clean room access fees
- Avoid contamination problems from multi-user evaporators
- Avoid reproducibility problems

**Features Include:**

- Plasma-cleaned surfaces
- Electron-beam deposited metal films
- Titanium adhesion layer
- Prepared in a dedicated clean environment
- Availability of ellipsometric constants
- Aluminosilicate glass - Near-zero Alkali Content (0.06 wgt %), High Softening Point (975℃) and High Optical Transmittance (92% over a range of 300-1100 nm)

## APPLICATIONS

Gold substrates can be utilized in the following applications:

**Cell Culture**

Substrates are prepared in an electron beam evaporator that is solely dedicated to the deposition of gold films. This prevents the occurrence of impurity metals (e.g., trace levels of Cu) contaminating the gold films, as is the case when multi-user equipment is used to coat gold substrates



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**Microarrays**

Gold substrates are prepared in an electron beam evaporator using titanium, not chromium, as the adhesion layer. This avoids the contamination that can occur when a thin layer of chromium is used to promote adhesion of the gold film to an underlying substrate (such as a glass microscope slide), since chromium readily dissolves and diffuses to the surface of the gold film (and can adversely modify the reactivity of the gold).

**Surface Plasmon Reflectometry**

Substrates are deposited using an electron beam evaporator, which permits precise control of gold deposition rates and thus the surface roughness. This ensures a high level of control over the thickness and nanometer-scale surface roughness of gold films, as is necessary in order to generate reproducible results with surface plasmon reflectometry.

**Scanning Probe Microscopy**

Substrates deposited on mica can be thermally annealed or transferred to epoxy resin (reverse mounting) to form atomically flat surfaces suitable for scanning probe microscopy

## QUESTIONS AND ANSWERS

### Are the substrates cleaned before coating them with gold?

All of our substrates are cleaned with oxygen plasma prior to coating.

### Do I have to be careful not to scratch the gold on the substrates?

We use source gold that is 99.999% pure - the coatings essentially are "24-karat," which means that the surface is somewhat prone to being scratched if it is not handled carefully. This is not a defect with the coating, it is simply the nature of this metal. Coating adhesion to the substrate is excellent due to the thin titanium layer that is deposited between the substrate and the gold layer. Our own researchers routinely wash gold-coated surfaces with a variety of solvents with no problem.

### Why is titanium used as the adhesion layer?

We use titanium, not chromium, as the adhesion layer, because chromium has been known to diffuse into the overlying gold over time more quickly than titanium.

### Which substrate provides the smoothest surface?

That depends. If you need a smooth substrate surface, choose Gold-coated Silicon Wafers (AU.1000.SL1 or AU.1000.SL2). However, if you want the actual surface of the gold to be as flat as possible, choose Gold-coated Mica (AU.2000.MC1 or AU.2000.MC2) and thermally anneal it by flame or furnace. This will result in gold with atomically flat terraces. The Gold-coated aluminosilicate slides also allow for annealing to improve surface roughness.

### Why might I want atomically flat terraces of gold on my substrates?

Flame annealed gold substrates can provide atomically flat terraces that may be used in many surface science fields including the following:

- Electrochemistry: To study the plating of surfaces with different components
- Biosensors: The gold is covered with self-assembled monolayers of different organic molecules
- Nanowetting: To study the wetting properties of liquids at the nanoscale level
- And others...

### What is the orientation of the gold surface on the substrates (what lattice plane is 'up')?

On several substrates (glass, mica) evaporated gold shows a significant tendency, but not an absolute driver, to assume a <111> orientation, which can be greatly enhanced if the coating is properly annealed for a few hours at around 450°C. Deposited onto Silicon (100), however, the gold coating appears to be highly polycrystalline, with <111> orientation being perhaps marginally preferred. Please note that this information is derived from the literature (see below).


1. *M.O. Watanabe et al., J. Vac. Sci. Technol. B 9, 924 (1990): "Scanning tunneling microscopy observations of crystal growth of deposited gold films during annealing." Quote: "Before annealing, the surfaces consisted of rolling hills and valleys without any atomically flat regions. ... after annealing at 320°C for 3.5 - 17 hr, ... an enlarged STM image [indicates] a (111) surface."*

2. *Y. Golan et al., Surface Sci. 264, 312 (1992): "Vacuum-deposited gold films I. Factors affecting the film morphology" Quote: "Evaporation of gold onto glass or mica produces large, flat crystallites, with a pronounced {111} texture, while on smooth silicon (100) it results in non-textured films."*

3. *M. Aguilar et al., Thin Solid Films 317, 189 (1998): "Electromigration in gold thin films." Quote: "The surface of the gold films grown by evaporation on glass is very rough with a typical granular structure with hills of various heights and widths statistically distributed on the surface. ... Basically, the peak in the diffractogram corresponding to the <111> orientation is (relative to the standard) more intense than the other ones."*

4. *M. Aguilar et al., Surface Sci. 482-485, 935 (2001): "Rough growth fronts of evaporated gold films, compared with self-affine and mound growth models." Quote: "Gold was thermally evaporated on polished Si(100) substrates at 30 C under controlled conditions of growth rate, 20 A/sec. ... the only preferred orientation normal to the substrate is (111)."*


### How are ellipsometric constants measured?

We measure ellipsometric constants for one substrate (not all of the substrates) from a given deposition. The constants are sent with the coated substrates when such data are requested by the customer at the time the original order is placed. This assumes that the coating being ordered is sufficiently reflective (i.e., thick) to allow ellipsometric measurements to be properly made.

### Can I purchase glass microscope slides coated with just titanium (and not gold)?

Yes, we can custom coat glass with just titanium. This will be a custom order.

### Can I purchase gold-coated substrates that are gold coated but without a titanium adhesion layer?

Yes, we can custom coat gold without titanium. This will be a custom order.

## Glass Microscope Slides

### Can I immerse gold-coated slides in thiol-based solutions?

Glass slides coated with 100/500 angstroms of gold over a thin titanium adhesion layer may be immersed in a solution of 1.0 millimolar thiol in ethanol. The slides certainly may be immersed for one hour at room temperature; however, they have also been immersed for as long as 24 hours at room temperature with good success.

### What are the glass specifications of the microscope slide substrates?

Glass Description and Specifications:

1. Standard substrate format (25 mm x 76 mm x 0.70 mm)
2. Flat to 3.5 micrometer over 25 mm (optical flat)
3. Refractive index of 1.52 (400-700 nm)
4. Transmission of >90 % (380-700 nm)
5. Thermal strain point: 666℃
6. Coefficient of thermal expansion: 42.0 x $10^{-7}$/℃ (25 -671℃)

## Mica

### Can I cut the mica?

Gold-coated mica may be cut with either a sheet metal bench shear or a sharp pair of scissors. We do not suggest using a scalpel or hobby knife as they might tear the coating along the edge of the mica.

If you plan to anneal the gold and want to preserve this flatness as much as possible, we suggest that our standard mica substrates first be coated, then cut to size, then annealed. It may be of benefit to first cut to size prior to coating if preserving coating properties is absolutely critical.

## Silicon Wafers

### What is the difference between surface 'flatness' and surface 'roughness'?

Surface 'flatness' is typically measured from an imaginary plane across the center of the wafer. Data points are then taken from that imaginary plane to the top surface of the wafer. The specification is given as GTIR (Global Total Indicated Readout) which covers multiple data points across the wafer.

The typical GTIR for the standard coated wafers (test grade wafers) is <15 microns. We can also custom coat 'prime grade wafers', which have a typical GTIR of <5 microns. Superflat wafers with a GTIR of <3 microns are also available for coating on a custom basis. This flatness can be achieved only with a double side polished wafer.

Surface 'roughness' is measured in angstroms rms. It is a measurement of the hills and valleys on the topical surface, polished side. This number is not specified or measured much for the typical semiconductor user. We cannot quote this specification for a test grade wafer; however, a standard of 20 angstroms rms or better for a prime grade wafer is a good approximation.

# PRICING FOR GOLD-COATED SUBSTRATES

| Catalogue No. | Description | Size |
|---|---|---|
| AU.0100.ALSI | Aluminosilicate Glass Microscope Slides with 100 angstroms gold over a 20 angstrom titanium adhesion layer (1 inch x 3 inches x 0.7 mm) | 5 slides |
| AU.0100.CSR | Glass coverslips with 100 angstroms gold (15 mm round) over a titanium adhesion layer, 0.13 to 0.16 mm thickness | 24 coverslips |
| AU.0100.CSS | Glass coverslips coated with 100 angstroms gold (22 mm square) over a titanium adhesion layer, 0.13 to 0.16 mm thickness | 12 coverslips |
| AU.0500.ALSI | Aluminosilicate Glass Microscope Slides with 500 angstroms gold over a 25 angstrom titanium adhesion layer (1 inch x 3 inches x 0.7 mm) | 5 slides |
| AU.0500.CSS | Glass coverslips coated with 500 angstroms gold (22 mm square) over a titanium adhesion layer, 0.13 to 0.16 mm thickness | 12 coverslips |
| AU.1000.ALSI | Aluminosilicate Glass Microscope Slides with 1000 angstroms gold over a 50 angstrom titanium adhesion layer (1 inch x 3 inches x 0.7 mm) | 5 slides |
| AU.1000.SL1 | Silicon Wafers (4 inch) 525 µm thickness with 1000 angstroms gold over a titanium adhesion layer | 3 wafers |
| AU.1000.SL2 | Silicon Wafers (4 inch) 525 µm thickness with 1000 angstroms gold over a titanium adhesion layer | 12 wafers |
| AU.2000.MC1 | Mica 90-150 µm thickness (easily cut) with 2000 angstroms gold (1 inch x 1.5 inches) | 1 piece |
| AU.2000.MC2 | Mica 90-150 µm thickness (easily cut) with 2000 angstroms gold (1 inch x 3 inches) | 1 piece |

** Ellipsometric constants are available at an extra charge for items with 1000 Å or greater of gold **


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