Gold Thin Films

What is a gold thin film?

- A nanometer-scale film of gold deposited onto a supporting substrate

What are gold thin films used for?

- Gold thin films have diverse applications in life science research, sensor development, reflectivity analysis, surface plasmon resonance detection, atomic force microscopy, and more

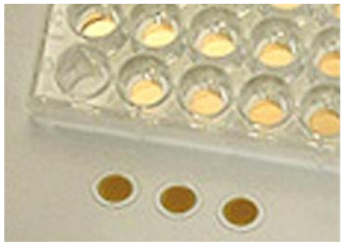
What are the benefits of gold thin films?

- Chemically inert surfaces, resistant to oxidation
- Excellent conductors of electricity
- Readily functionalized, especially with alkanethiol monolayers
- Available with optional atomically smooth surface as "**ultra-flat**" gold

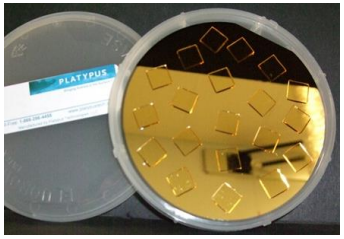
Platypus Gold Thin Film Products

Microscope slides
10 nm, 50 nm, 100 nm
gold films

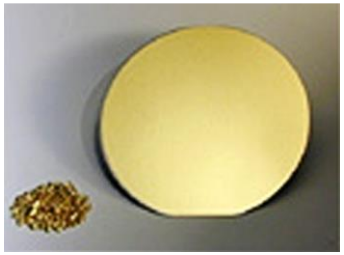
Mica
200 nm gold film



Coverslips
22 mm square:
10 nm, 50 nm gold films
15 mm round: 10 nm gold film

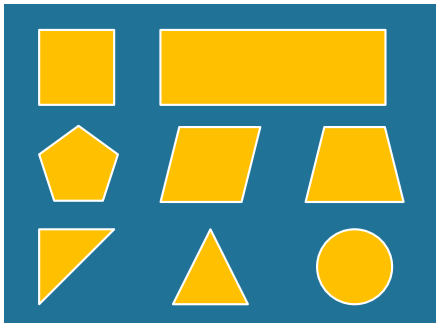


Ultra-Flat Films
100 nm on glass
200 nm on mica



Silicon wafers
100 nm gold film

Platypus Custom Gold Thin Films



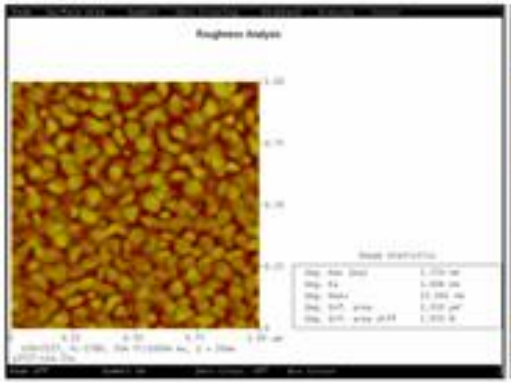
Custom gold and titanium coatings on your substates of glass, silicon, or mica

Substrate Dimensons	Minimum 10 x 10 x 0.1 mm (0.25 x 0.25 x 0.0025 in) Maximum 165 x 165 x 3 mm (6.5 x 6.5 x 0.12 in)
Substrate Type	Vacuum-compatible to 10^{-7} Torr
Gold Thickness	Minimum 0 nm, Maximum 300 nm (<7.5 nm may not provide a continuous coating)
Titanium Thickness	Minimum 0 nm, Maximum 50 nm (<7.5 nm may not provide a continuous coating)

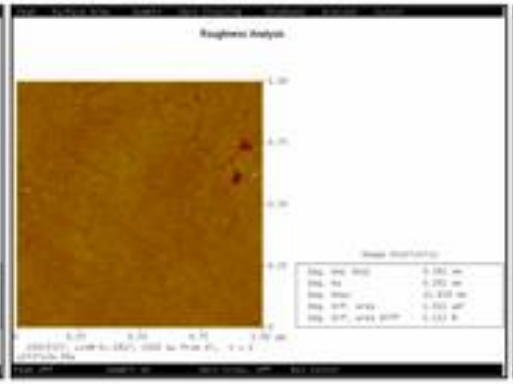
Platypus® Ultra-Flat Gold Films

Template Stripped Gold Chips provide an extremely smooth and clean gold surface for a variety of research needs, including AFM, SEM, sensor development, and surface chemistry studies.

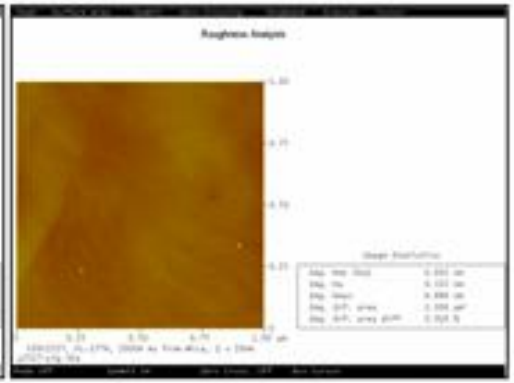
AFM Characterization: RMS roughness over a randomly selected 1 μm^2 area



1um² AFM scan of as-deposited gold on Silicon Wafer
RMS roughness = 17.3Å



1um² AFM scan of Platypus® Template Stripped Gold – Silicon Wafer
RMS roughness = 3.6Å



1um² AFM scan of Platypus® Template Stripped Gold – Mica
RMS roughness = 4Å

Goniometer Characterization: Water static contact angle

Surface Condition	Static Contact Angle
As-Deposited Gold (fresh)	25 - 40°
As-Deposited Gold (after exposure to atmosphere for 5 hours)	75 - 90°
Template Stripped Gold Chip (stripped prior to reading)	25 - 40°
Note: All measurements carried out at ambient temperature.	

Platypus Custom Glass Scribing

Accurate, diverse shapes for flat substrates:

	Inches	Millimeters
Thickness	0.004 - 0.2	0.10 - 5.00
Max sheet size	24 x 24	600 x 600
Rectilinear accuracy	± 0.002	± 0.0508
Shape accuracy	± 0.003	± 0.0762
Minimum curve radius	0.1	2.5

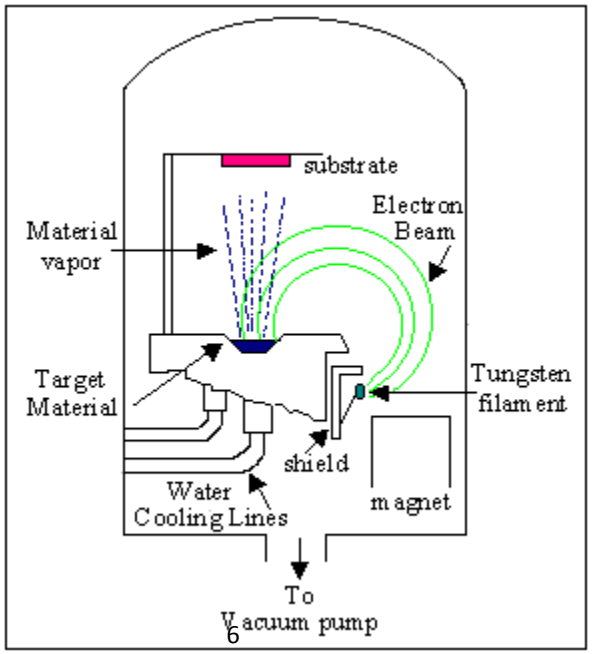
For substrates < 1 x 3 inches that require gold coating, we recommend coating larger sheets and scribing to size after coating

Gold Coating Methods

- **Thermal vapor deposition:** The material to be deposited is evaporated by electrical resistive heating at low pressure and is condensed onto the substrates

- **Sputtering:** The material to be deposited is ejected from a source by plasma discharge which is then deposited onto the substrates

- **Electron-beam vapor deposition:** The material to be deposited is heated to a high vapor pressure by electron beam bombardment in an ultra-high vacuum and is condensed onto the substrates. This method is used by Plastypus because it produces the smoothest, cleanest gold surfaces



Advantages of Platypus Gold Films

Ultra Clean Substrates	Substrates are cleaned by oxygen plasma prior to coating to promote adhesion and cleanliness
Dedicated E-beam Coater	Only titanium and gold are used for coatings to ensure that the gold thin films are as pure as possible
Cleanroom Facility	The gold coatings are applied in a class 10,000 cleanroom to reduce particulate contamination
High Reproducibility	Dedicated gold coating equipment, a 99.999% pure gold source, calibrated deposition control, and consistent quality control measurements all contribute to the high reproducibility
Titanium Adhesion Layer	Titanium is a better adhesion layer than Chromium. Chromium can diffuse into the gold film faster, contaminating it
Low RMS Roughness	Roughness of Platypus' gold coated substrates will depend on the thickness of gold and type of substrate it is on, but generally the RMS roughness is between 1.5 and 4nm
Custom Coatings	Platypus can work with customers to coat custom substrates with specified titanium and gold thicknesses

Critical Parameters

Thickness of gold layer

For most applications a 10 - 100nm thick gold thin film is used.

10-nm gold films are transparent whereas 100-nm gold films are opaque

Roughness

A root mean square (RMS) roughness < 4 nm is desired for most applications. However, for certain scanning probe applications a lower roughness is required, which Platypus offers as **ultra-flat gold films**

Surface purity

A clean surface is required for applications that employ gold surface modifications. Depending on the deposition process used, level of vacuum, purity of the gold source, and history of metals used in the coating equipment, the level of gold thin film purity can vary greatly between suppliers. Platypus uses only gold, titanium and vacuum-compatible substrate materials to ensure maximum cleanliness of gold thin films

Cleaning Your Gold Films

Atmospheric Deposition

Our gold thin films are fabricated in a clean room. However, it is challenging to prevent atmospheric components, especially organic compounds, from adsorbing to the highly active gold surface once they are in a typical laboratory atmosphere. We suggest users clean the gold immediately before use.

Cleaning Gold Thin Films

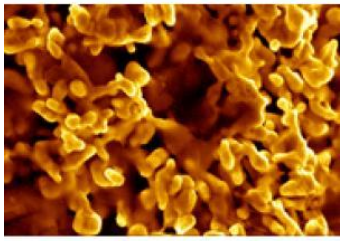
If you plan to create self-assembled monolayers of alkanethiols on the gold, there is no need to clean the surface. The attachment of the alkane thiols is energetically favored over adsorbed atmospheric contanimants, and the alkanethiols will displace these.

Otherwise, a brief exposure to a butane flame will clean the surface of contaminants. We like **this butane torch model**, it is easy to use and after you have done your experiment you can use it to make crème brûlée.

Glossary of Terms

Nanometer (nm): $1x10^{-9}$ m

Ångström (Å): 0.1 nm



E-beam Evaporation: A physical vapor deposition technique used for thin film coatings.

Adhesion Layer: A thin layer deposited for improving the adhesion of gold to the substrate.

Roughness: A measure of surface smoothness.

Grain Size: The size of gold grains present on the surface. Grain size impacts roughness.

Self Assembled Monolayers (SAMs): A single layer of molecules, most commonly alkanethiols, that spontaneously assemble into monolayers on a gold surface.

Questions?

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