



USER MANUAL

Preparation & Application of Gold-on-Glass Substrates

Step-by-step instructions for thermal reconstruction (Flame Annealing) to achieve atomically flat Au(111) terraces.

arrandee™ Precious Metal Coated Substrates

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1. Introduction to arrandee™ Substrates

arrandee™ manufactures high-purity, gold-coated borosilicate glass substrates specially designed for high-resolution microscopy (Scanning Tunneling Microscopy/STM and Atomic Force Microscopy/AFM) as well as for the investigation of Self-Assembled Monolayers (SAMs).

The substrates consist of a precisely cut borosilicate glass carrier (D263, thickness approx. 0.7 mm) onto which a layer of ultra-high-purity gold (99.999%) is deposited without any additional adhesion layers (such as chromium or titanium). The nominal gold thickness is standardly 250 nm.

ADVANTAGE OF OMITTING ADHESION LAYERS

By eliminating chromium or titanium adhesion layers, thermal diffusion of foreign atoms to the surface during annealing is completely prevented. This guarantees a chemically absolutely pure gold substrate for sensitive surface analyses.

2. Transport, Storage & Handling

To preserve the outstanding purity and quality of arrandee™ substrates, strict cleanliness standards must be observed:

- **Storage:** Always store unused substrates in their original packaging under inert gas (nitrogen or argon) or in a vacuum desiccator. This minimizes the adsorption of organic contaminants from the ambient air.
- **Handling:** Handle the substrates exclusively by their edges using specially cleaned stainless steel or Teflon tweezers. Never touch the coated gold surface directly.
- **Laboratory Cleanliness:** If possible, work under a laminar flow hood or in an extremely low-dust laboratory environment.

3. Thermal Reconstruction (Flame Annealing)

In the freshly delivered state, the vacuum-deposited gold film exhibits a polycrystalline, granular structure. To obtain atomically flat, wide terraces with the desired **Au(111) orientation**, the substrate must be thermally treated ("annealed") immediately prior to the measurement. Flame heating (Flame Annealing) is the most efficient and proven method for this in daily laboratory practice.

Required Equipment

1. A small gas burner operated with **hydrogen (recommended)**, propane, or butane.
2. An absolutely clean quartz glass plate or ceramic holder to serve as a heat-resistant surface.
3. Fine, heat-resistant tweezers (e.g., made of ceramic or stainless steel).

4. A dimmed laboratory environment (allows accurate visual assessment of the glowing temperature).

SAFETY NOTICE FOR HANDLING GASES

Operating open gas burners – especially with hydrogen – carries a risk of explosion and fire. It is mandatory to work under a fully functional laboratory hood, wear safety goggles and heat-resistant gloves, and have fire extinguishing equipment ready.

Step-by-Step Instructions

1. **Preparation:** Place the arrandee™ substrate with the gold side facing up on the clean quartz glass surface. Dim the room lights enough so that you can easily observe a faint glow.
2. **Ignition:** Light the burner and adjust it to a fine, non-sooting, light-blue flame (approx. 2–3 cm in length).
3. **Preheating:** Guide the flame slowly in circular motions over the entire substrate to heat the glass evenly and prevent thermal stress cracks.
4. **The Actual Annealing:** Aim the hottest part of the flame directly at the substrate. Move the flame steadily and evenly across the gold surface. The substrate should exhibit a **very faint, dull orange-red glow**. This corresponds to a temperature of approx. 650 °C to a maximum of 750 °C.
Duration: approx. 30 to 60 seconds of continuous movement.
5. **Cooling:** Slowly withdraw the flame to lower the temperature gradually. Allow the substrate to cool down on the quartz plate in ambient air (or under a light stream of nitrogen) for at least 2 minutes before moving it.

4. Technical Specifications

The following table summarizes the key physical parameters of arrandee™ gold-on-glass substrates:

Parameter	Specification / Value
Base Material	Borosilicate glass D263 (controlled flatness, approx. 0.7 mm thickness)
Gold Purity	99.999% (certified by melt metallurgy)
Nominal Gold Thickness	250 nm ($\pm 10\%$)
Adhesion Layer	None (free of chromium, titanium, or other foreign metals)
Terrace Size (after Annealing)	Typically 100 nm up to several 100 nm flat Au(111) domains

5. Frequently Asked Questions (FAQs)

Q: Why does the glass crack during heating?

A: This is usually caused by heating or cooling too rapidly or unevenly. Make sure to preheat the substrate globally and slowly in the first step to prevent thermal shock in the borosilicate glass.

Q: How can I tell if the gold has been overheated?

A: If the glow becomes too bright (yellow-orange to yellow), the gold melts locally. Due to surface tension, it beads up into macroscale gold droplets, destroying the flat surface. The substrate is then unusable.

Q: How long does the substrate remain clean after flame annealing?

A: In regular laboratory air, the adsorption of organic molecules begins immediately. We strongly recommend using the substrate within 10 to 15 minutes after cooling down for your measurement or modification (e.g., immersion in thiol solutions).