



Purpose: To coat grids with gold

Authors:

Approved:

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1. Purpose:

- 1.1. To be able to evaporate gold on to grids.

2. Scope:

- 2.1. To be able to set up and operate the gold evaporation machine.
- 2.2. To be able to prepare quality gold grids.

3. Definitions

- 3.1. In high vacuum, evaporated gold particles travel directly to the grids without colliding with the background gas.
- 3.2. Gold grids are believed to improve image quality and resolution by reducing particle movement during imaging and provide thinner ice after plunge freezing.

4. Responsibilities:

- 4.1. Prepare evaporation source (when using an old wire start from step 4.1.6).
 - 4.1.1. Start off wiping the chamber with ethanol and a non-abrasive wipe, i.e. Kimwipe
 - 4.1.2. Continue by cutting approximately 15 cm of tungsten wire (18 gauge, approx. 1 mm in diameter).
 - 4.1.3. Bend a nice V-shape in the middle of the wire.
 - 4.1.4. Shorten the wire appropriately.
 - 4.1.5. Pre-clean the wire by inserting the wire in the evaporator, pump down and heat the wire to make it glow (approx. 2 amps) for 5 mins.
 - 4.1.6. Inspect the wire, the V-shape that glows most brightly should be a clean gray color, if not repeat steps 4.1.5-4.1.6.
 - 4.1.7. Wrap approx. 1 foot (longer dimension of an A4 paper) of gold wire (Ted Pella 0.008" diameter; 29cm weighs about 0.176g) around the tip of the V.
 - 4.1.8. Attach source in the evaporator, make sure there are no unwanted contacts and center with the point of the V facing downwards.
- 4.2. Prepare your grids
 - 4.2.1. Use your desired grids.
 - 4.2.2. Inspect each grid under an optical microscope (look for broken and crinkled carbon film, and impurities; discard poor grids).
 - 4.2.3. Clean the grids with chloroform, acetone and isopropanol.
 - 4.2.4. Inspect them again.
 - 4.2.5. Place grids, carbon side up, on a cleaned glass slide.
 - 4.2.6. Place a square cover slip at the other end of the slide.
 - 4.2.7. Place the loaded glass slide in the evaporator, make sure the source, grids and shutter are centered in the chamber.
- 4.3. Evaporate
 - 4.3.1. Pump down, wait until the vacuum reaches 10^{-7} mbar range, use LN2.
 - 4.3.2. Insert shield between the source and the grids.
 - 4.3.3. Make sure to wear protective eye wear, tinted goggles, while evaporating the gold



- 4.3.4. Gradually increase the current until the tungsten wire starts to glow red (approx. 1.2 amps with 18 gauge wire).
- 4.3.5. Continue increasing the current slowly and observe the gold wire, once the wire starts to melt approx. 1.4 amps with 18 gauge wire) stop and wait until the wire is completely molten.
- 4.3.6. Once the gold droplet is formed raise the current by 0.05-0.1 amps and remove shield, current may drift during the evaporation process.
- 4.3.7. Aim for 400-500Å thick layer of gold and deposit slowly, about 1Å per second (6min 40sec for 400Å & 8min 20sec for 500Å).
- 4.3.8. The glass slide will change color as gold is deposited on it, green is 150-200Å, the color darkens and turns gray as the gold layer thickens, gold colored layer is about 500Å thick.
- 4.3.9. Turn off the current, leave in vacuum to cool down (10-20mins) and then remove grids from the evaporator.
- 4.4. Carbon film removal
 - 4.4.1. Inspect grids as before evaporation.
 - 4.4.2. Flip the grids around.
 - 4.4.3. Insert the grids in the plasma cleaner.
 - 4.4.4. Run "c removal" or another recipe that uses O2 and Ar for 6 minutes to strip the carbon layer.

Title	c removal	O2 Gas Flow	5.0 sccm
Visible	Yes	H2 Gas Flow	0.0 sccm
Cleaning Time	6:00	Ar Gas Flow	45.0 sccm
Vacuum Target	21 mTorr	Gas Flow Timeout	20 seconds
Vacuum Range	0 mTorr	Forward RF Target	38 W
Pumping Switch Point	20 Torr	Forward RF Range	5 W
Turbo Pump Speed	750 Hz	Maximum Reflected RF	5 W
Pumping Timeout	120 seconds	RF Tuning Timeout	4 seconds
Repeat	No	RF Tuning Attempts	3

4.4.5. Check your grids as before.

5. Personal protective Equipment (PPE):

- 5.1. Laboratory coat
- 5.2. Nitrile gloves
- 5.3. Goggles (tinted)

6. Chemicals:

- 6.1. Chloroform



- 6.2. Acetone
- 6.3. Ethanol
- 6.4. Isopropanol

7. Equipment

- 7.1. Glass Slides
- 7.2. Gold Wire
- 7.3. Grids
- 7.4. Tweezers
- 7.5. Kimwipe
- 7.6. Solarus Plasma Cleaner/Glow Discharger
- 7.7. Edwards Auto 306

8. Waste Disposal:

- 8.1. N/A

9. Vendors:

- 9.1. Ted Pella .008" diameter; 29cm weighs about 0.176g