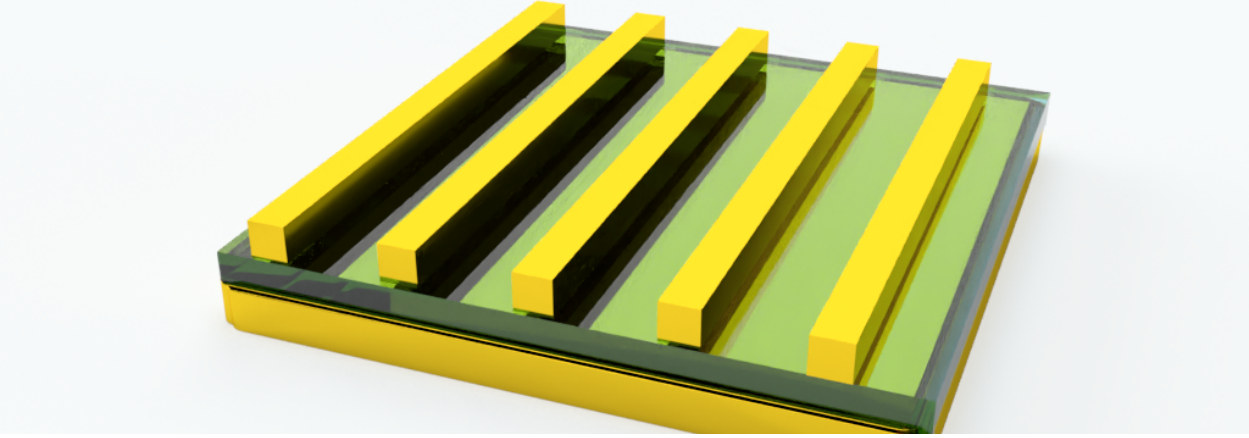

Standard Operating Procedures

Anqi Ji and Skyler Selvin
E241 Spring 2021

Mentors:
Tony Ricco, Mark Zdeblick, Swaroop Kommera, and Graham J. Ewing

Gold-PDMS adhesion enhancement

Spun PDMS adhesion enhancement to gold surface

Materials:

1. Sylgard 184
2. Gold substrates (or inert substrates with gold adhered to the top)
3. (3-mercaptopropyl) trimethoxysilane ($HS(CH_2)_3Si(OCH_3)$) 95%
4. Anhydrous ethanol
5. Glassware or disposable plastic containers
6. Parafilm

Tools:

1. Mixer to mix PDMS: *thinky-mixer*
2. Spinner for coating PDMS on substrates: *spincoat-g3p8*
3. Oven for curing PDMS: *thermoscientific-oven*
4. Vacuum chamber for removing bubbles in spun PDMS: vacuum chamber in Mavericks (Allen 155)
5. Wet bench with fume hood for MTPMS processing
6. Bath sonicator

Procedure:

I. MPTMS deposition on gold

In a fume hood, wearing nitrile gloves and PPE:

1. Add 60 uL to 40 ml of anhydrous ethanol to create about a 7.5 mM solution of MPTMS in a glass or plastic container.
2. Cover solution with parafilm to form an airtight seal.
3. Sonicate for 5 min to mix solution in a bath sonicator at max power. The sonicator must be inside fume hood.
4. Remove parafilm and place substrates directly in MPTMS solution or pour MPTMS solution into appropriate size container and place substrates inside.
5. Cover the container with parafilm to make an airtight seal.
6. Soak samples for a minimum of 30 min (longer is generally better).
7. Remove parafilm and substrates and spray wash with anhydrous ethanol on both sides of sample for 15 s.
8. Blow dry with N_2 gun.

Notes:

MPTMS is extremely smelly. Even extremely small amounts of extremely diluted solution will stink up an entire room of taken out of the fume hood. All handling of the MPTMS must take place inside the fume hood. Gloves must be disposed of in a sealed bag before being removed from the fume hood. All glassware used must be thoroughly washed before removal from the fume hood.

II. PDMS deposition on MPTMS coated gold surface:

In a fume hood, wearing disposable gloves:

1. Combine Sylgard 184 at a ratio of 1:10 = hardening agent: elastomer (w/w).
2. Mix PDMS in *thinky-mixer* for standard mix cycle of the mixer.
3. Place substrate on PDMS spin coater *spincoat-g3p8*.
4. Spin for 1-2 min at 3000 rpm to get about 25 um of thickness.
5. Place in vacuum chamber for 10-30 min.
6. Cure in *thermoscientific-oven* at 100 C for >35 min.

Evaporated gold adhesion enhancement to PDMS

Materials

1. PDMS substrates (or inert substrate with PDMS coated on top)
2. (3-mercaptopropyl) trimethoxysilane ($HS(CH_2)_3Si(OCH_3)$) 95%
3. Anhydrous ethanol
4. Glassware or disposable plastic containers
5. Parafilm

Tools

1. Electron beam evaporator: *aja_evap*
2. Wet bench with fume hood for MTPMS processing
3. Bath sonicator
4. Ultraviolet ozone plasma (UV/O_3) machine: Jelight model 24

Procedure:

I. MPTMS deposition on PDMS

1. UV/O_3 treat PDMS substrate for 5 min to create hydroxyl groups on surface. Allow 10 min exposure to air after UV/O_3 treatment.

In a fume hood, wearing nitrile gloves and PPE:

2. add 60 uL to 40 ml of anhydrous ethanol to create about a 7.5 mM solution of MPTMS in a glass or plastic container.
3. Cover solution with parafilm to form an airtight seal.
4. Sonicate for 5 min to mix solution in a bath sonicator at max power.
5. Remove parafilm and place UV/O_3 treated PDMS substrate directly in MPTMS solution or pour MPTMS solution into appropriate size container and place substrate inside.
6. Cover container with parafilm to make an airtight seal.
7. Soak sample for a minimum of 3 hours. Longer is generally better. Although the authors did for only ~30 min, longer is recommended.
8. Remove parafilm and substrates and spray wash with anhydrous ethanol on both sides of sample for 15 s.
9. Blow dry with N_2 gun.

II. Gold deposition on PDMS surface

1. Using an electron beam evaporator, deposit gold at 0.05 nm/s onto the MPTMS coated PDMS surface.

Notes:

The rate of deposition was not swept with our experiments but may change the performance of the MPTMS adhesion significantly. Evaporated Au may damage the MPTMS monolayer upon contact, and toying with the deposition rate may be a way of reducing this damage.