Improving adhesion and preventing collapsing of Nanoscribe resist IP-Dip

Poor adhesion of the IP-Dip photoresist to your substrate may lead to detachment during further characterization like the vacuum environment in scanning electron microscopes, and further processing like template-assisted electrodeposition (Figure 1).

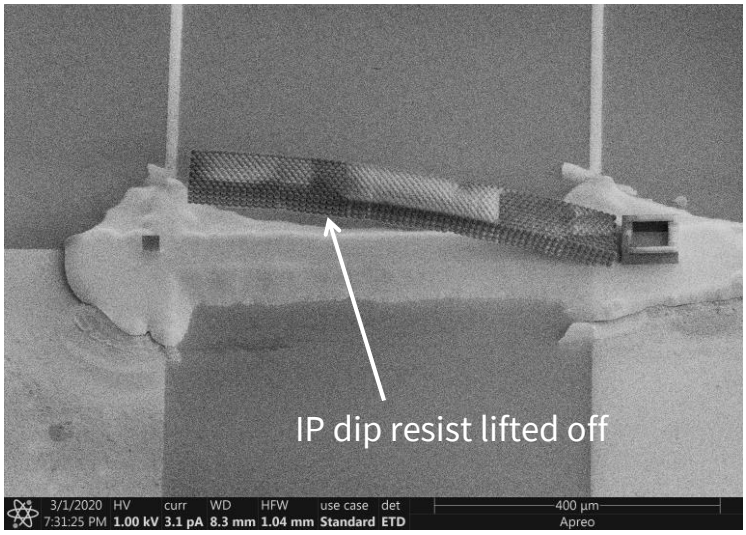


Fig. 1. Poor adhesion of IP-Dip photoresist to the substrate – IP-Dip photoresist being lifted off by the electrodeposited metal underneath

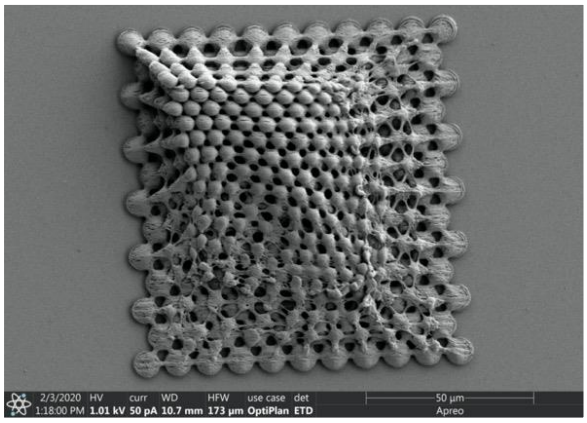
An improved substrate pretreatment protocol is therefore developed that results in better adhesion. We tested this successfully with Ti-Au patterned fused silica substrates.

Substrate pretreatment protocol for better adhesion

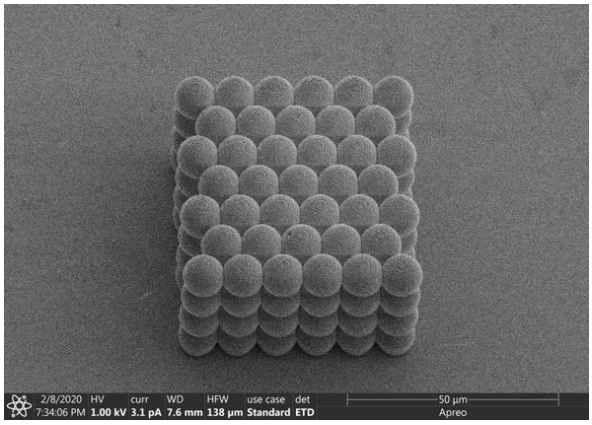
1. Acetone + sonication
→ Remove organic contaminants
2. Isopropanol
→ Prevent stain forming from acetone
3. Plasma, 2 min in technics
→ Further descum the surface
4. Yes2 oven
→ Salinization of surface (hydrophobic)

People may also encounter a structural collapsing effect during the development and drying process of IP-Dip, and other negative resists. The cause of the structural collapsing is due to the

capillary force of the solvent during its drying process after development of the photoresist [6]. Lower doses result in lower tensile strength of the structure, and lead to more severe collapsing (Figure 2).



Collapsed structure after development
30% power both main body and base 19k um/s
SU-8 dev + IPA + N_2 blow dry



Improved structure after development
power 60% main body, 40% at base, 20k um/s
SU-8 dev + HFE7100 + evaporation dry

Fig. 2. Structural collapsing and its mitigation

An improved exposure and development process are developed that results in better shape and less collapsing effect. Note that if you work with a reflective substrate like a Ti-Au patterned substrate, it might be difficult to increase the dose because it may lead to severe bubbling of the photoresist. If this happens, we suggest setting different values for the doses near the substrate-resist interface and the main body, by setting different laser power and scanning speeds for “base” and “solid” in DeScribe software. You can also change the setting of your “base” and “solid” layer thickness when you import the STL file in DeScribe.

Mitigating structural collapsing of IP-Dip

1. Higher dose during exposure
→ Increasing the cross-linking of the polymer (IP-Dip) by increasing the laser power or decreasing the scanning speed
2. Replace isopropanol with HFE7100
→ Low surface tension fluids to mitigate capillary force
3. Allow for air dry by evaporating the solvent
→ Replace blow dry with nitrogen