



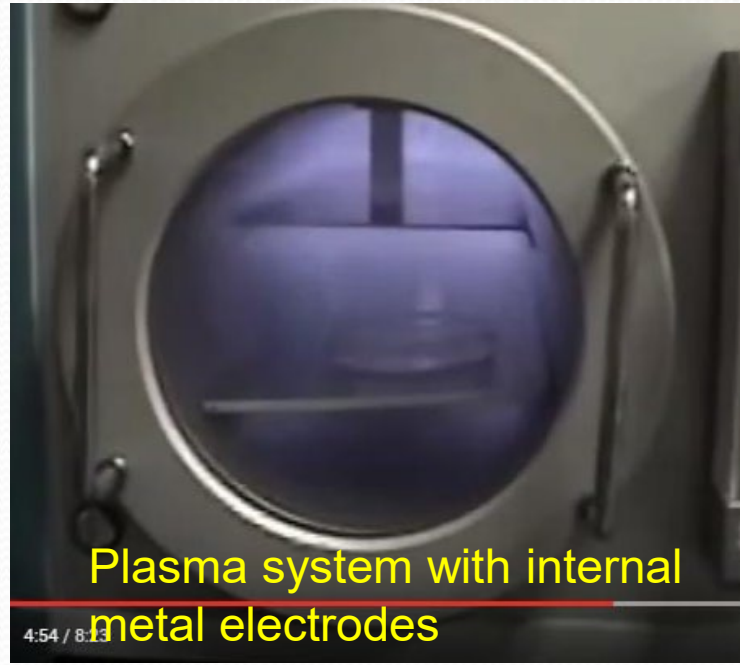
Sample surface cleaning & treatment

Remove surface contamination and
change surface energy to make sample
surface either hydrophilic or hydrophobic

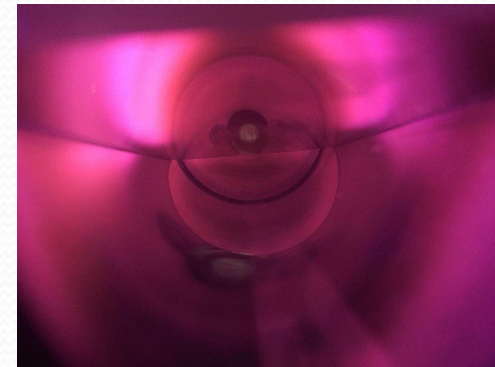
Better uniformity and lower contamination



Tergeo plasma cleaner



Plasma system with internal metal electrodes



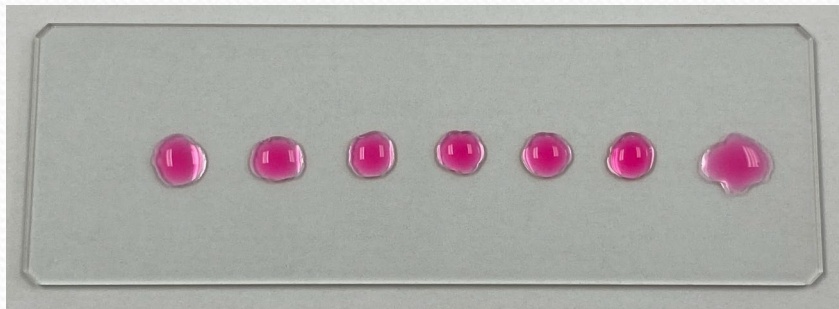
Inductive coil antenna design in some low cost plasma cleaner results in bad uniformity

Better uniformity. Plasma discharge technology in Tergeo plasma cleaner originates from the research carried out in the Plasma & Ion Source Technology at the Lawrence Berkeley National Laboratory. The difference in plasma color is because of the different process gas. Tergeo plasma cleaner clearly has much better uniformity. Bad uniformity means bad process control.

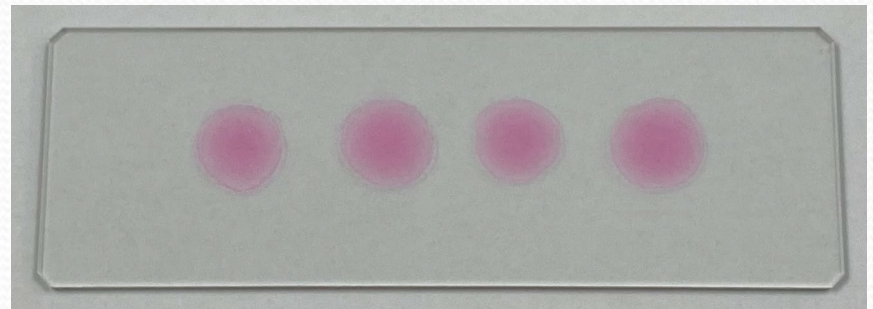
Lower contamination: Electrodes are placed outside of the quartz tube in Tergeo plasma cleaner. Ions can't reach the metal electrodes. If high voltage metal electrode is placed inside the plasma chamber, ions will be accelerated to high energy and sputter metal out of the electrodes. Metal will then deposit onto the samples and cause metal contamination issue. Metal sputtering contamination issue is especially severe if KHz rf power supply is used to generate the plasma.

Glass before and after air plasma cleaning

Hydrophilic surface treatment



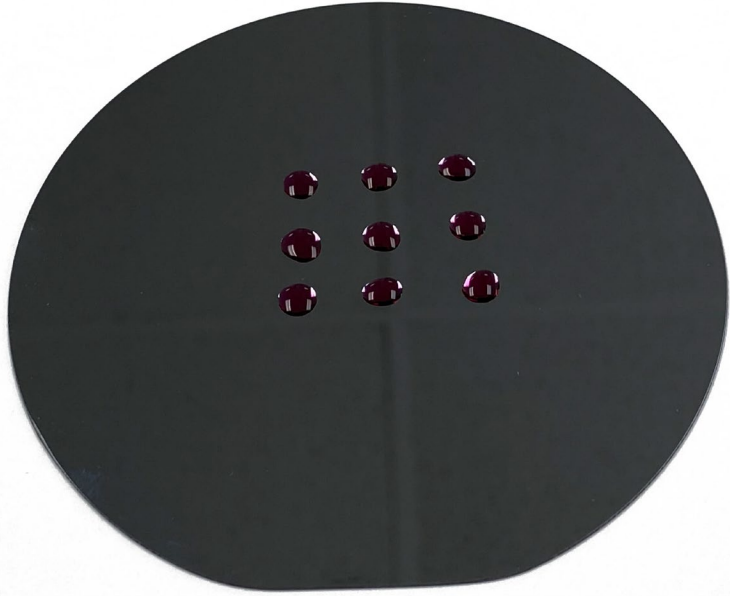
Glass slides before
plasma clean



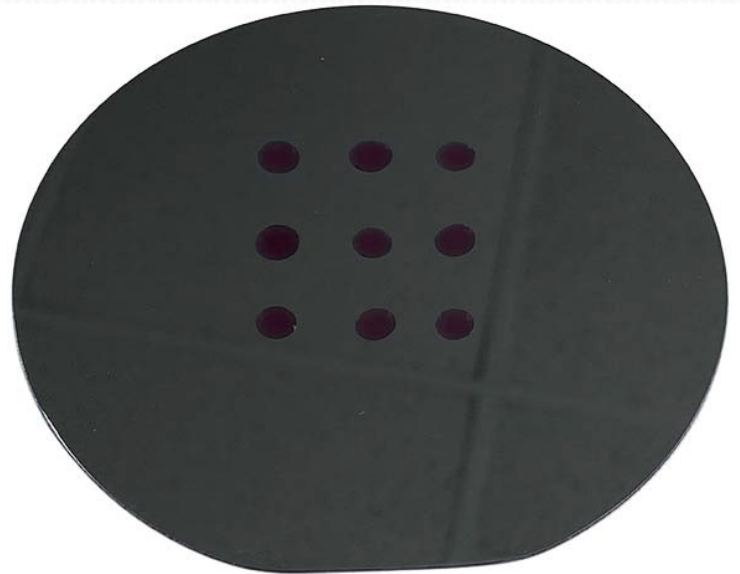
After 1-minute air
plasma cleaning

4" silicon wafer cleaning before spin coating

Hydrophilic surface treatment



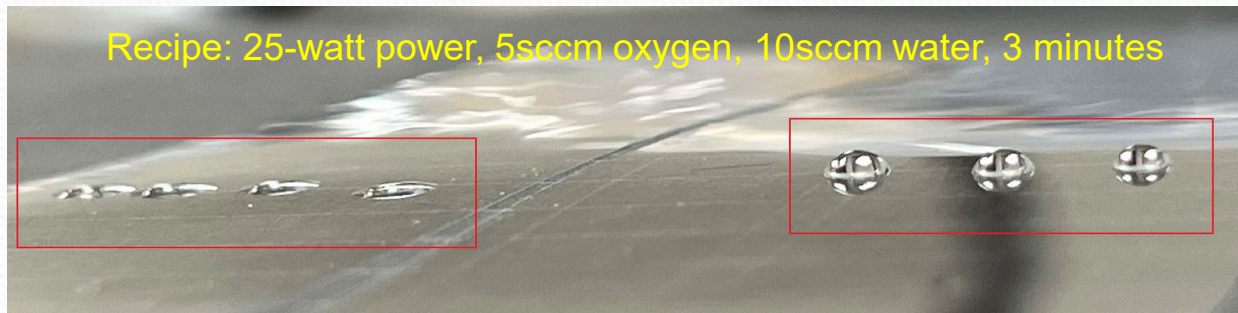
Silicon wafer before
plasma clean



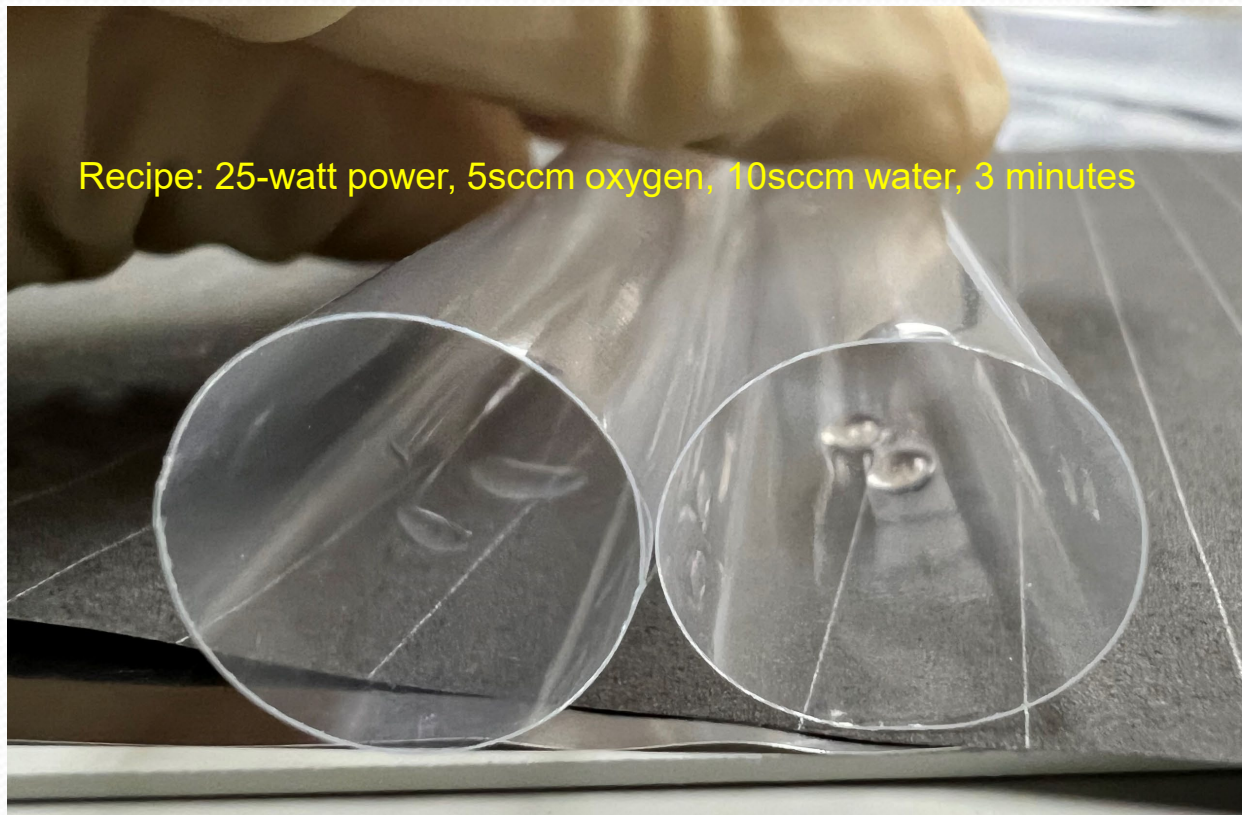
After 2-minute air
plasma cleaning

The background image on the wafer is the reflected ceiling

Surface treatment of plastic film & tube



PET film
Left side: plasma treated
Right side: untreated

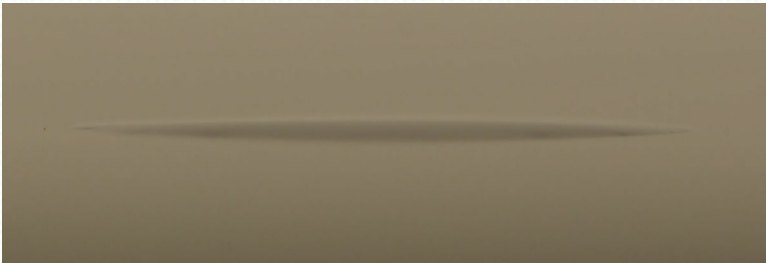


PET tube
Left side: plasma treated
Right side: untreated

Water vapor plasma and surface energy



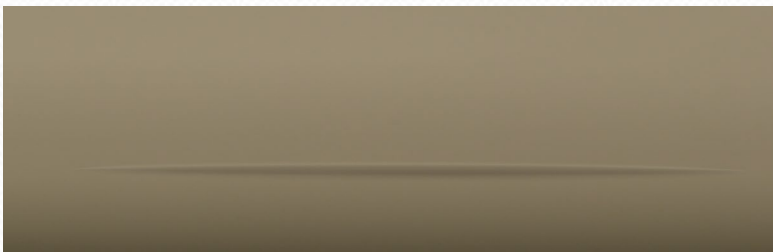
Air exposed and contaminated silicon wafer.
Contact angel 12 degrees.



After short plasma cleaning 15W (20% pulse duty ratio), 30 seconds. The remaining water in the chamber generate some OH* hydroxyl functional group, which render the surface hydrophilic. Contact angel 3-4 degrees.



After 150W (100% pulse duty ratio, e.g. CW) strong plasma cleaning for 5 minutes. Contact angle increased because the water in the plasm chamber is totally depleted. Plasma can't generate OH* hydroxyl functional groups anymore. Surface become more hydrophobic. Contact angel 23 degrees.



1 minute 25Watt (100% pulse) [water vapor plasma](#) cleaning and processing. Contact angle reduces because water vapor plasma deposit high density OH* hydroxyl functional group on the surface. Contact angel 1-2 degrees.

Water vapor plasma delivery kit



Many surface treatment applications need to render the surface super hydrophilic. Process gasses, such as ambient air, argon, oxygen, nitrogen, can render the sample surface hydrophilic. But they rely on the water moisture absorbed on the wall of the plasma chamber, sample surface, or by-products (H_2O) generated by oxygen oxidation of organic materials. Plasma can break up H_2O gas molecules and generate OH^* functional groups, which will then deposit on the sample surface and render the sample surface hydrophilic. Long & strong plasma cleaning can totally deplete the absorbed water inside the chamber.

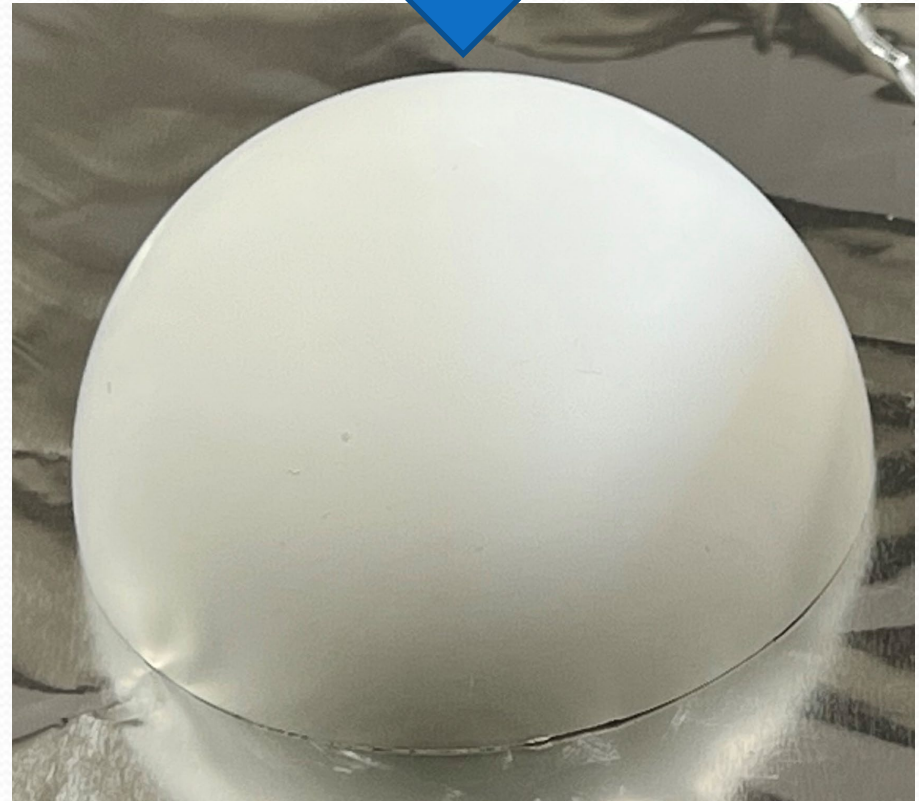
Our water vapor plasma delivery kit will change one of the regular MFCs on the Tergeo plasma machine to a special MFC that can work with low-vapor-pressure, non-corrosive, non-toxic liquid. It can deliver up to 10sccm water vapor at the room temperature without heating up the external enclosed water bottle. Besides the modification on the MFC, the water vapor plasma delivery kit also includes an external water bottle, a valve, and a filter that can prevent the water droplet from being sucked into the MFC. Water vapor plasma is very beneficial for making the surface of inorganic materials hydrophilic, for PDMS bonding, glass slides treatment and many other bio-medical applications

Increase surface roughness and improve bonding strength

Before plasma etching, surface is smooth, shiny, and have surface contaminations



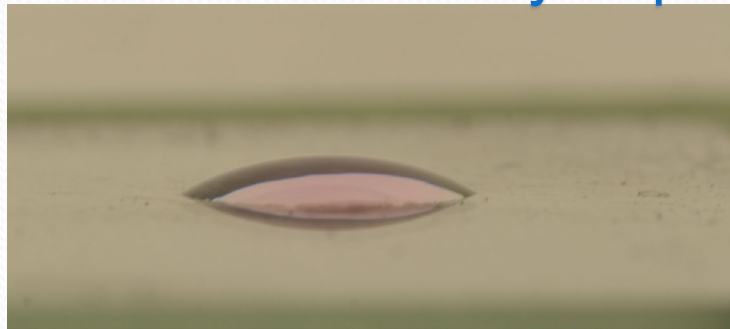
After plasma etching, the surface is roughed (the reflected light looks diffused) and looks cleaner



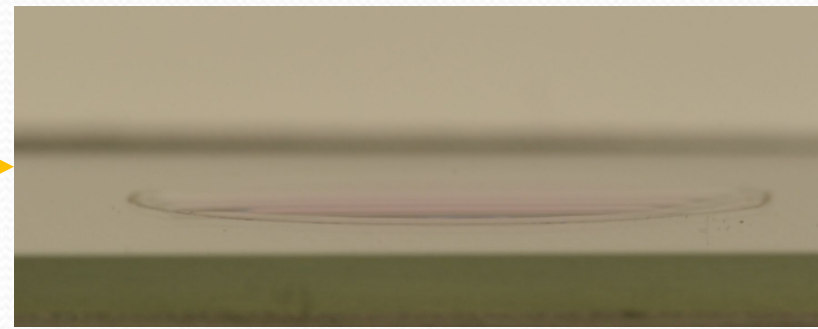
Etched with CF₄+O₂ plasma at 150Watt rf power

Rendering the glass slides to super hydrophilic, then to strongly hydrophobic

Hydrophilic surface treatment

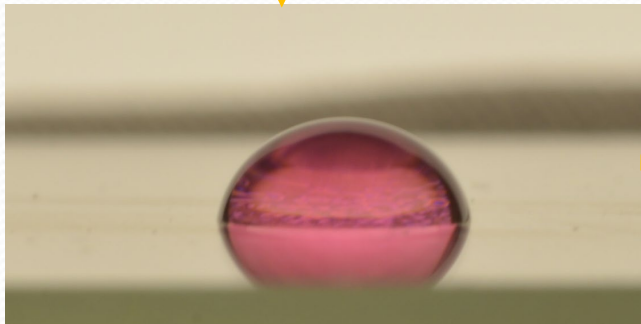


Original glass slides

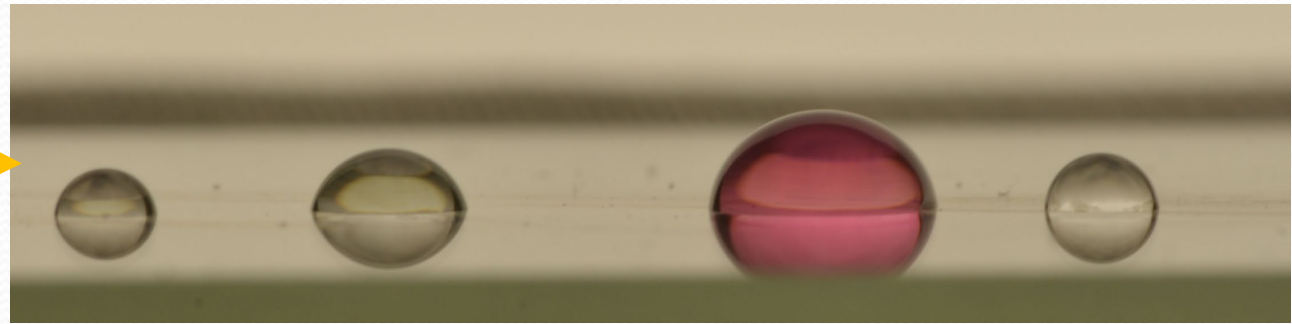


After 1-minute air plasma treatment

Hydrophobic surface treatment



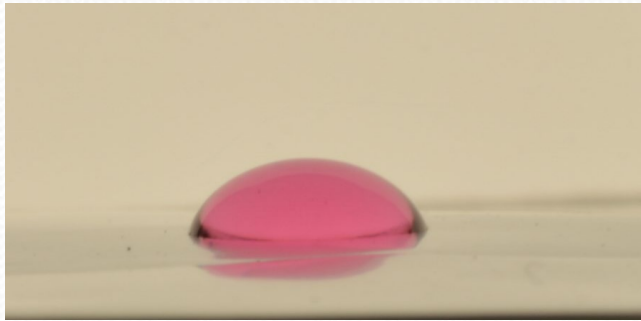
Right after proprietary hydrophobic plasma surface treatment



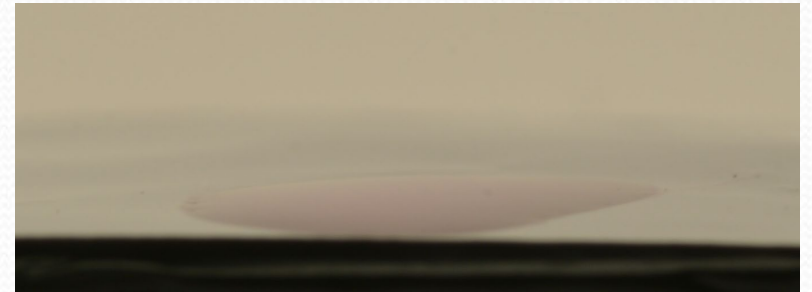
15 hours after hydrophobic surface treatment

Rendering the aluminum foil to super hydrophilic, then to strongly hydrophobic

Hydrophilic surface treatment

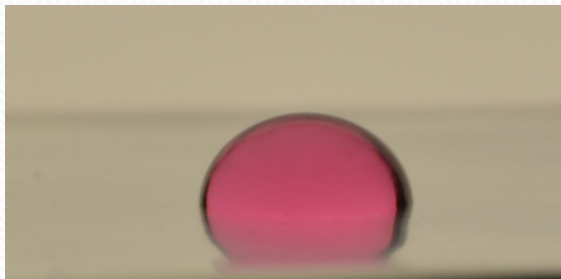


Aluminum foil before cleaning

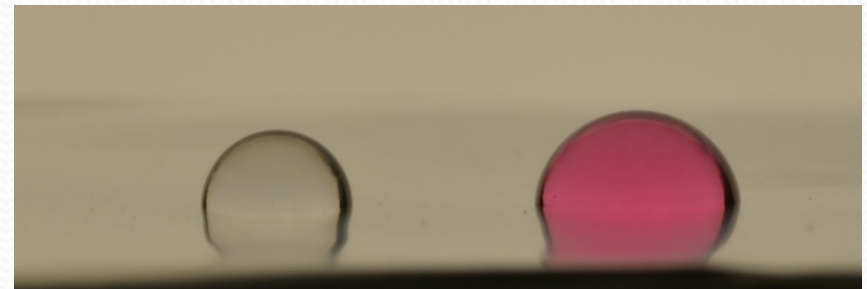


Aluminum foil after air plasma cleaning

Hydrophobic surface treatment

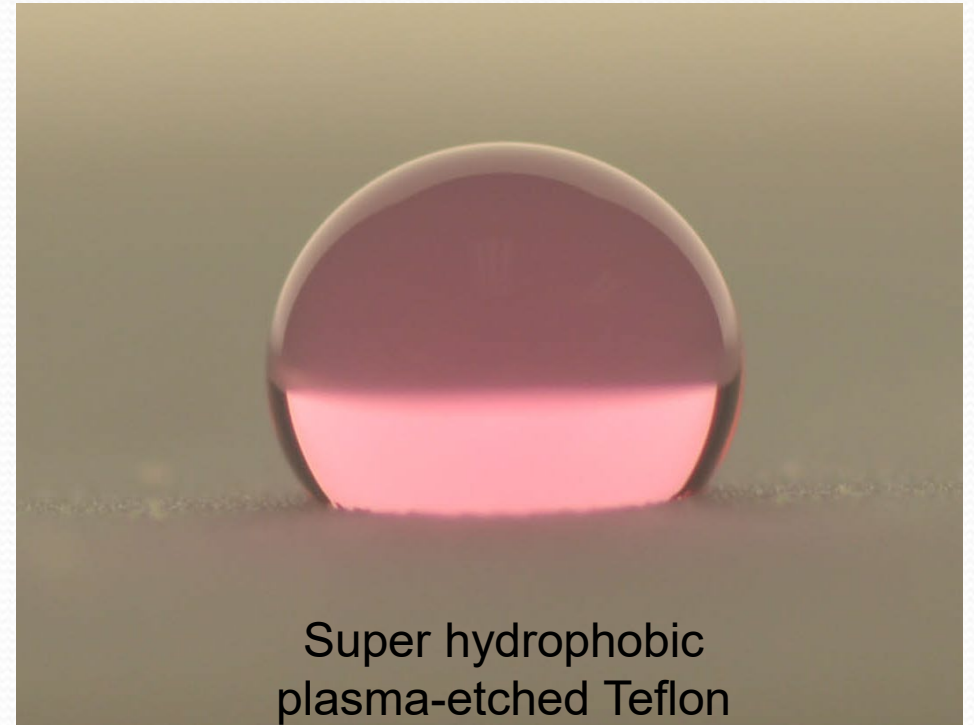
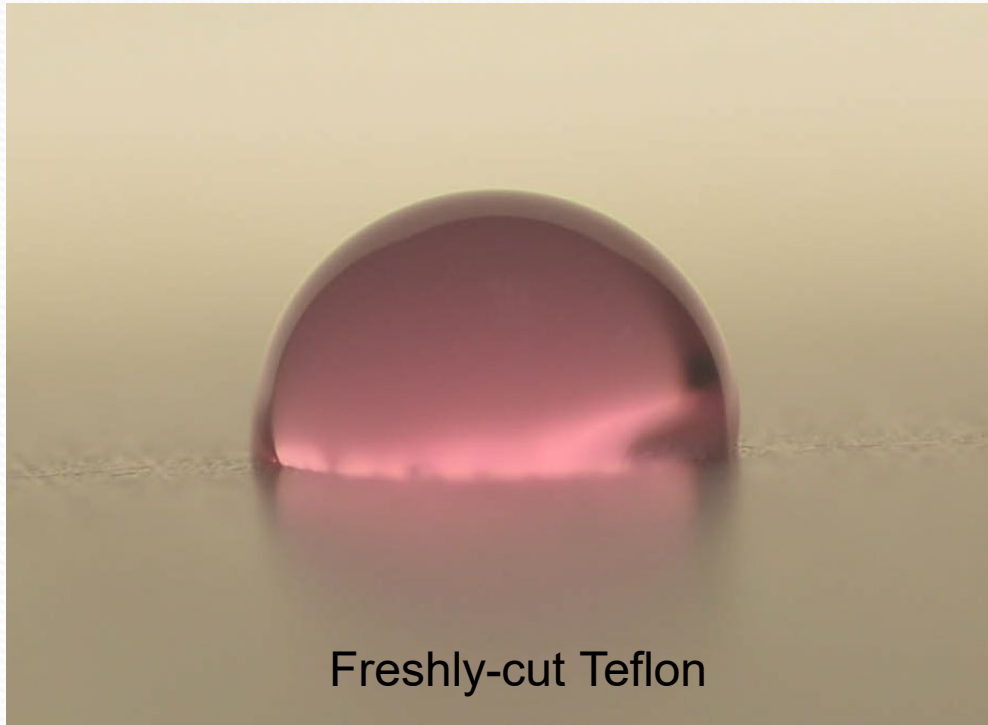


Right after proprietary hydrophobic plasma surface treatment



15 hours after hydrophobic surface treatment

Super hydrophobic Teflon



Teflon surface is strongly hydrophobic. But it's still not enough for some applications. We can make Teflon surface super-hydrophobic. Plasma-etched Teflon can show higher water contact angle and higher surface roughness than the freshly-cut Teflon. The surface of the plasma-etched Teflon looks like a white diffuser because of the microscale surface roughness.