PLASMA APPLICATIONS:
Plasma Cleaning

For references citing the use of our plasma cleaners, categorized by research application, see the References: Technical Articles page.

Benefits of Plasma Cleaning

- Remove organic contaminants by chemical reaction (O_2 or air plasma) or physical ablation (argon plasma)
- Eliminate the use of chemical solvents as well as storage and disposal of solvent waste
- Clean surfaces with microscale porosity or microchannels not suitable for solvent cleaning due to surface tension limitations
- Render most surfaces hydrophilic; decrease water droplet contact angle and increase surface wettability [Figure 1] (see also Surface Adhesion and Wettability)
- Promote adhesion and enhance bonding to other surfaces
- Prepare surface for subsequent processing (e.g. film deposition or adsorption of molecules)
- Sterilize and remove microbial contaminants on the surface; beneficial for biomedical applications and biomaterials (see also Biomaterials)
- Clean surface without affecting the bulk properties of the material
- Can treat a wide variety of materials as well as complex surface geometries; examples include:
  - Semiconductor wafers and substrates (Si, Ge)
  - Glass slides and substrates
  - Optics and optical fibers
  - Oxides (quartz, indium tin oxide (ITO), TiO_2, Al_2O_3); mica
  - Gold and metal surfaces
  - Electron microscopy (EM) grids
  - Atomic force microscopy (AFM) cantilever tips

Applications

- Clean substrates to reduce background autofluorescence originating from organic contaminants for fluorescence microscopy
- Clean optics, crystals (quartz, Ge, ZnSe), cuvettes, and substrates for spectroscopic measurements (ATR-FTIR, UV-Vis, SERS)
- Clean quartz crystals for quartz crystal microbalance (QCM) measurements
- Clean AFM cantilever tips for surface morphology and frictional force measurements
- Clean electron microscopy (EM) grids, specimen holders, and substrates
- Clean printed circuit (PC) board and die surface prior to bonding
- Clean gold surfaces for self-assembly experiments

Processing Methods

- Oxygen or air plasma
  - Removes organic contaminants by chemical reaction with highly reactive oxygen radicals and ablation by energetic oxygen ions
  - Promotes hydroxylation (OH groups) on the surface
  - May oxidize the surface; oxidation may be undesirable for some materials (e.g. gold) and may affect surface properties
- Argon plasma
  - Cleans by ion bombardment and physical ablation of contaminants off the surface
  - Does not react with the surface or alter surface chemistry
- For applications that are sensitive to potential contamination from trace impurities (e.g. Ca, K, Na) in borosilicate glass, a quartz chamber is recommended over the standard Pyrex chamber
- Suggested process parameters values for plasma cleaning using a Harrick Plasma cleaner (some experimentation may be required to determine optimal process conditions)
  - Pressure: 100 mTorr to 1 Torr
  - RF power: Medium or High
  - Process time: 1-3 minutes
  - Low RF power may be used to minimize surface roughening; the process time may require adjustment to compensate for the lower power

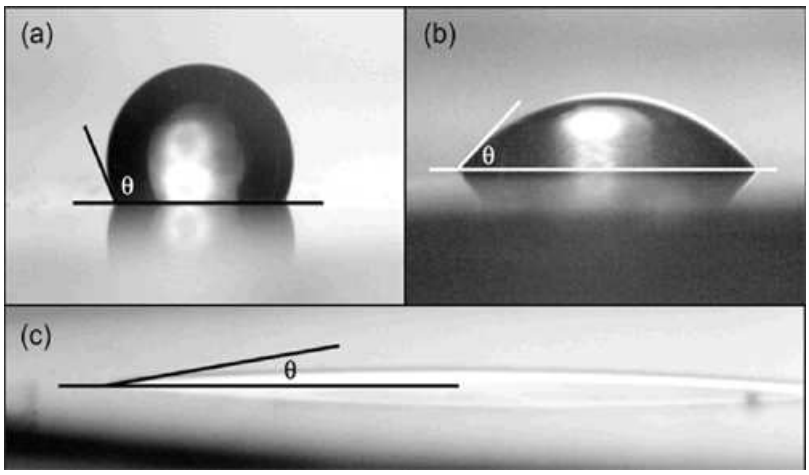

Figure 1. Water droplet contact angle measurements on 3 different borosilicate glass surfaces: (a) halocarbon wax-coated (92°), (b) untreated (32 ± 2°), and (c) argon plasma-cleaned using a Harrick Plasma cleaner (<10°). Source: Sumner, A. L., E. J. Menke, Y. Dubowski, J. T. Newberg, R. M. Penner, J. C. Hemminger, L. M. Wingen, T. Brauers, B. J. Finlayson-Pitts. "The Nature of Water on Surfaces of Laboratory Systems and Implications for Heterogeneous Chemistry in the Troposphere." Phys. Chem. Chem. Phys. (2004) 6: 604-613 - Reproduced by permission of The Royal Society of Chemistry (http://www.rsc.org/pccp).