PLASMA APPLICATIONS:
Biomaterials

For references citing the use of our plasma cleaners in biomaterials applications, see the Biology, Biomedical Applications, and Cleaning and Sterilization categories in the References: Technical Articles page.

Benefits of Plasma Treatment

- Enhance adhesion and modify surface wetting properties of biomaterials
  - Biomaterials are typically chemically inert and have low surface energies to minimize fouling and undesired interaction with other surfaces; these properties also make it difficult to effectively apply functional coatings or active molecular groups on the surface
  - Plasma treatment can render surfaces hydrophilic to improve adhesion for subsequent coating or adsorption of functional groups, or render surfaces hydrophobic through deposition of fluorinated end groups
  - Plasma treatment can enhance functionality and biocompatibility of biomaterial surfaces
- Sterilization
  - Oxygen plasma treatment can simultaneously clean and surface sterilize medical devices and biomaterials
  - Plasma sterilization is appropriate for medical or dental implants and devices that are sensitive to the high temperature, chemical or irradiative environments associated with autoclaving, ethylene oxide (EtO) or gamma sterilization, respectively

Applications

- Plasma activation of substrate surfaces to render surface hydrophilic; promote attachment and adhesion of functional biological species or coatings
  - Enhance cell adhesion, coverage, and proliferation on tissue scaffolds
  - Promote adsorption of selective functional biological species while resisting adhesion of bacteria and fouling microorganisms
  - Apply coatings on plasma-treated biomaterial surfaces to act as a protective barrier layer or lubricant in implanted medical devices
- Plasma cleaning and activation of microelectrode arrays for biosensors
- Sterilization of medical devices and biomaterials (e.g. dental implants, dental impression mold materials, tissue scaffolds)

Processing Methods

- Oxygen or air plasma
  - Removes organic contaminants by chemical reaction with highly reactive oxygen radicals and ablation by energetic oxygen ions
  - Promotes surface oxidation and hydroxylation (OH groups); increases surface wettability
  - Oxidation may be undesirable for some materials (e.g. gold) and can 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
- Carbon tetrafluoride (CF_4) plasma
  - Forms hydrophobic coating of fluorine-containing groups (CF, CF_2, CF_3)
  - Decreases number of polar end groups on surface; decreases surface wettability
- 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 treatment 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 require adjustment to compensate for the lower power