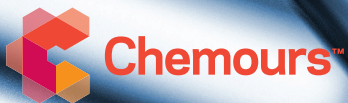


Teflon™ Fluoropolymers and the Semiconductor Industry

The Science of Pure Performance



Each day, smart devices are connecting our world in ways like never before. As our reliance on these devices grows, so does the demand for high-performance, low-cost semiconductor technologies.

By 2020, the Internet of Things will consist of over 50 billion connected devices. This impending technological revolution is driving the demand for increasingly powerful and efficient integrated circuits that will challenge the known limits of design scale and complexity. In order to meet the increasingly strict requirements of greater chip densities and higher yields, integrated device manufacturers (IDMs) will depend on fab system reliability and low defectivity like never before.

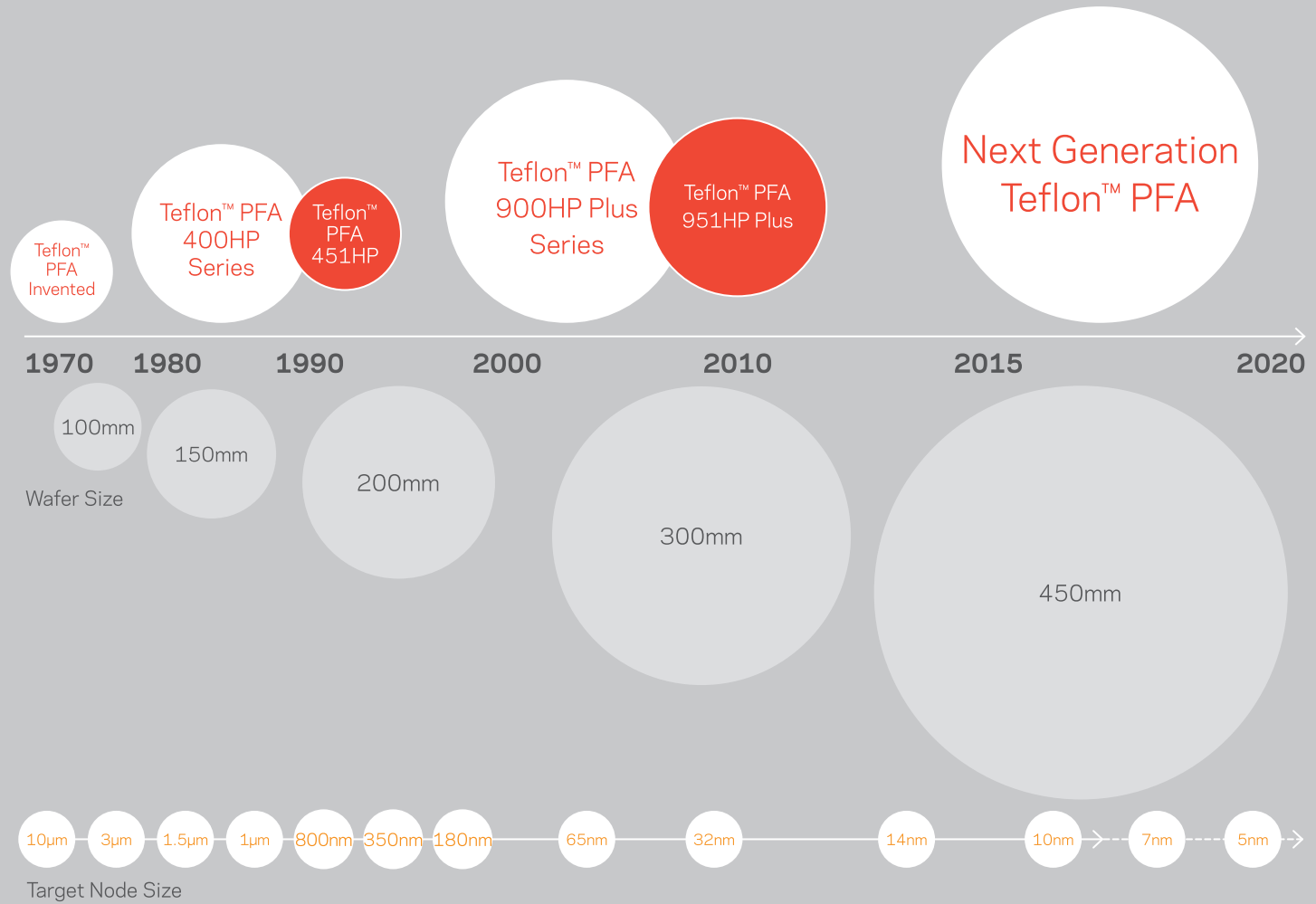
From bulk chemical distribution to wet etch and CMP processes, chemically inert Teflon™ fluoropolymers are used to enable the equipment and systems needed to deliver high-performance, contamination-free gases and chemicals during the IC manufacturing process.

Teflon™ fluoropolymers provide reliable, high-quality solutions—enabling device manufacturers to maximize chip yields and design freedoms while minimizing downtime and process variability.



50 billion connected devices by 2020

For over 50 years, the development of our Teflon™ PFA product line has evolved with the ever-changing needs of the semiconductor industry, and we will continue to develop the materials needed to meet the challenges of the future.



The End-to-End Solution for High-Purity Fluid Handling

IDMs rely on Teflon™ fluoropolymers to prevent contamination, corrosion, and leaching in fluid-handling systems that transport critical process fluids throughout the fab. Teflon™ fluoropolymers are chemically inert, reducing the risk of contamination and on-wafer defects. Components made from Teflon™ fluoropolymer resins offer unsurpassed protection against ionic and metallic contamination, even under the harshest conditions.

Teflon™ in the Fab



High-Purity Chemical Manufacture, Transport, and Storage

To protect against metal leaching from corrosion, electronics grade chemical manufacturers use storage and transport systems made from Teflon™ fluoropolymers to ensure the highest purity of their materials.

Bulk Chemical Distribution (BCD)

Bulk chemical distribution reduces costs of delivering chemicals from large bulk containers to use points. Systems often include automated equipment for diluting and dispensing chemicals. Teflon™ fluoropolymers are widely used throughout the BCD infrastructure of the fab.

Wet Etching, Stripping, and Cleaning

In wet processing, wafers are cleaned and etched and then cleaned again of photoresist and residuals from the etching process. Tool components made from Teflon™ fluoropolymers are used throughout these fluid delivery systems to help prevent contamination and ensure high yields.

Chemical Mechanical Planarization (CMP)

Chemical mechanical planarization levels wafer surfaces before vapor deposition and subsequent processing steps. The working fluid is a slurry of fine abrasive particles, chemicals, and water. In CMP, components made from Teflon™ fluoropolymers help guard against contamination of process fluids and slurries that come in contact with wafers.

Wafer Handling and Transport

Teflon™ fluoropolymer resins can be molded to form carriers for supporting wafers during wet processing. The nearly universal chemical resistance and high purity of Teflon™ fluoropolymers make it the ideal material for harsh chemical environments and applications involving direct wafer contact.

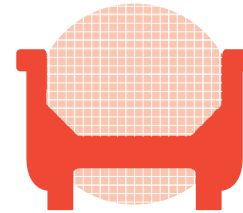
High-Purity Fluid Handling with Teflon™ Fluoropolymers

The use of Teflon™ fluoropolymers helps give industry innovators access to a wide array of world-class materials and expert technical support that facilitate the fabrication of semiconductor materials. Products like Teflon™ PFA, Teflon™ FEP, and Teflon™ PTFE are used to create everything from pipes to filters, sensors, and storage containers for high-purity, fluid-handling systems.



Tube and Piping Systems

- Teflon™ PFA HP and HP Plus tubing
- Teflon™ PFA HP and HP Plus valves and fittings
- Teflon™ PTFE gaskets and seals
- Anti-static Teflon™ PFA for applications requiring charge dissipation



Wafer Handling and Storage

- Teflon™ PFA HP and HP Plus wafer baskets and storage racks
- Anti-static Teflon™ PFA for applications requiring charge dissipation



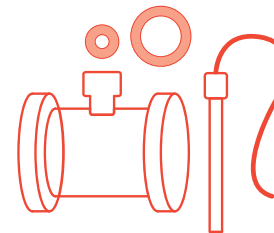
Tanks, Vessels, and Drum Liners

- Teflon™ PFA drums and containers
- Teflon™ PFA and PTFE tank and vessel liners
- Teflon™ PFA dip tubes and dispense systems



Filtration Systems and Membranes

- Teflon™ PTFE filtration membranes
- Teflon™ PFA HP and HP Plus filter housings and components



Flow Meters, Sensors, Pumps, and Exhaust Coatings

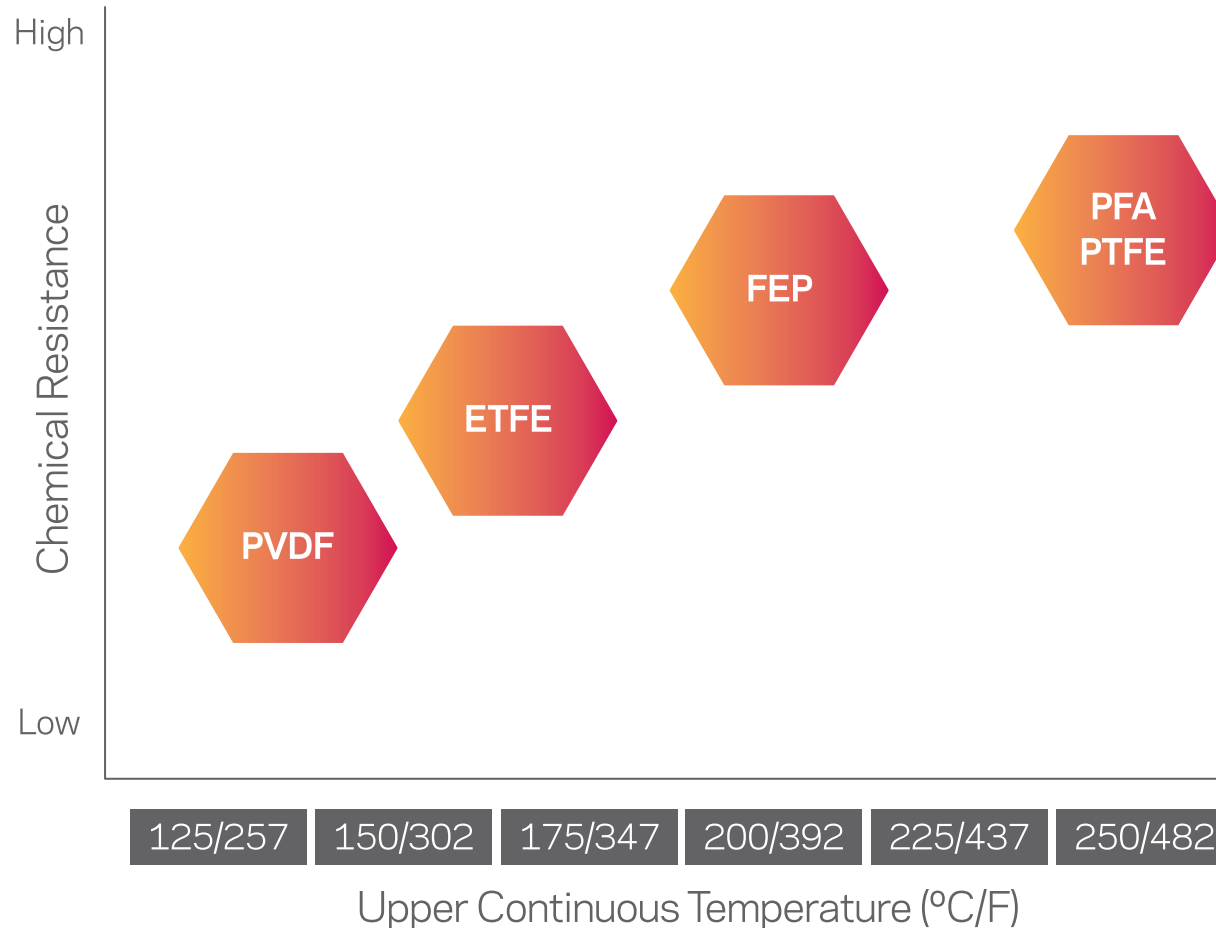
- Teflon™ PFA and PTFE flow meters
- Teflon™ PFA and PTFE bellows and pump components
- Teflon™ finishes duct coatings for corrosive exhaust systems
- Teflon™ finishes sensor and thermocouple coatings

Product Attributes



Unmatched Chemical Resistance at High Temperatures

Teflon™ PFA and PTFE fluoropolymers offer the highest combined chemical and temperature resistance of any thermoplastic material, making them the ideal choice for aggressive chemical mixtures used in semiconductor processes.



Product Attributes



A Diverse Selection of Material Solutions

Teflon™ and Tefzel™ fluoropolymers offer the highest levels of material performance to meet the needs of many demanding and diverse applications.

	Teflon™ PFA	Teflon™ FEP	Teflon™ PTFE	Tefzel™ ETFE
Melting point (°C/F) ¹	308/586	260/500	327/621	267/513
Upper continuous use temperature (°C/F)	260/500	205/401	260/500	155/311
Fully fluorinated ²	Y	Y	Y	N
Chemical resistance	■	■	■	■
Stress crack resistance ³	■	■	■	■
Optical clarity	■	■	■	■
Surface smoothness	■	N/A	■	N/A
Permeation resistance	■	■	■	■

■ Superior performance ■ Exceptional performance ■ Standard performance ■ Less than standard performance

¹ASTM D4951

²Not all grades within a given product family are fully fluorinated

³ASTM D2176; historic standard

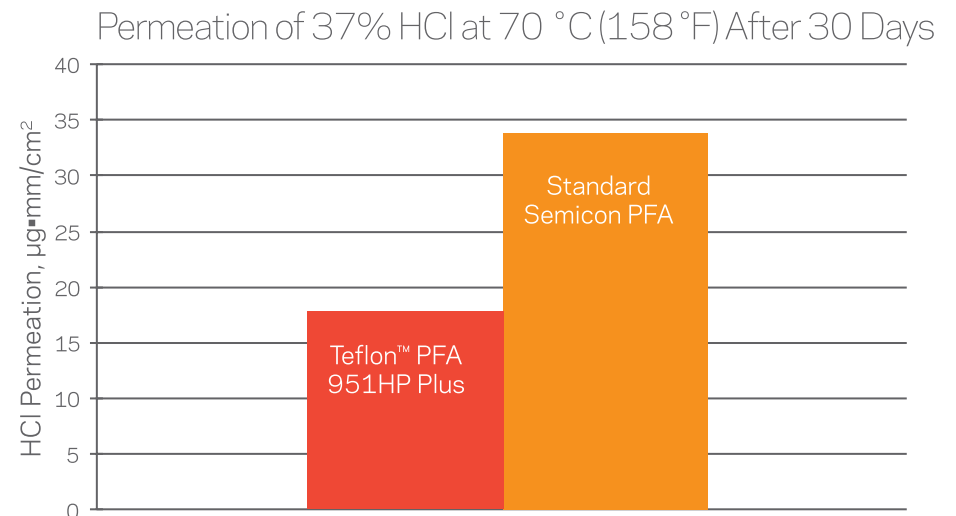
Featured Grades



Teflon™ PFA 951HP Plus: Unmatched, industry-leading permeation resistance

Teflon™ PFA 951HP Plus was designed with enhanced crystalline morphology to withstand permeation from even the most aggressive chemical systems and is particularly suited for use in acid and mixed acid distribution systems.

This high-purity resin also has enhanced resistance to stress-cracking, so that components can last longer under dynamic loads and resist damage caused by ozonated fluids and fluorosurfactants. This durability, plus near universal compatibility with semiconductor process fluids, helps maintain uptime and reduce cost of ownership.



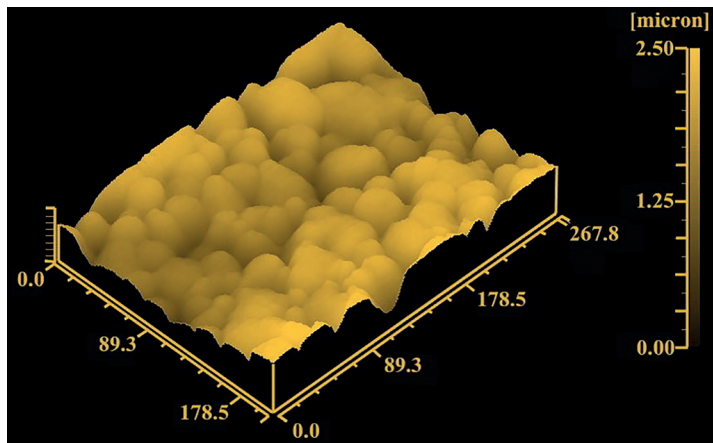
Featured Grades



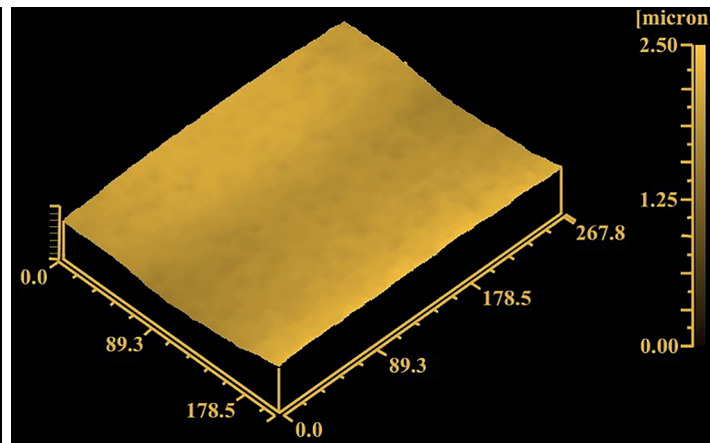
Teflon™ PFA 451HP:

Superior surface smoothness
and faster flushing performance

Teflon™ PFA 451HP offers superior surface smoothness over traditional PFA materials. Spherulite size control technology allows for smoother surfaces that lead to enhanced crystallinity for increased chemical permeation resistance, excellent cleanability, and faster flushing times, as well as ensuring the lowest levels of extractables and particles.



Conventional PFA



Teflon™ PFA 451HP

Featured Grades

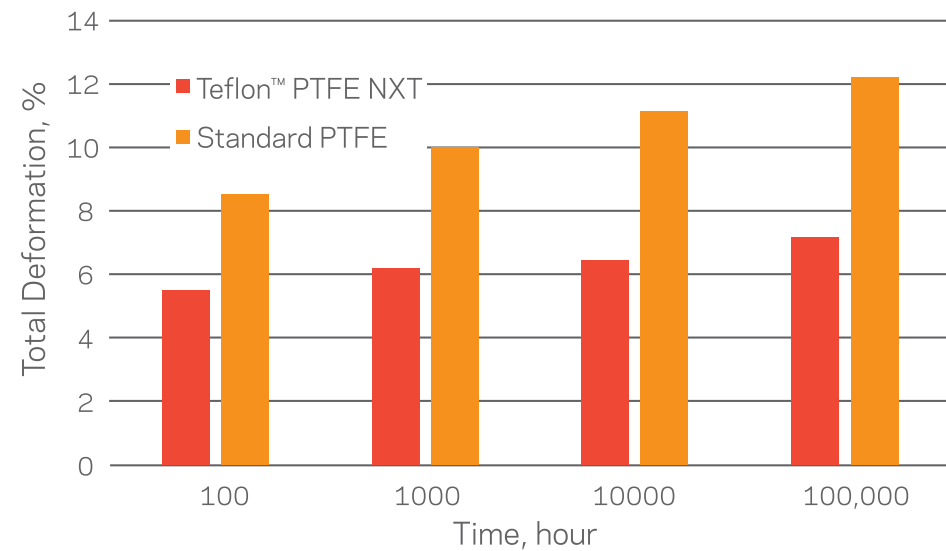


Teflon™ PTFE NXT: Improved properties boost reliability

Teflon™ PTFE NXT offers longer service in applications requiring flexing, in addition to higher elongation and lower creep and compression set. The superior elongation available with Teflon™ PTFE NXT can help components survive loads that would damage components of standard PTFE.

Seals, gaskets, and other components subjected to compressive loads stay in shape better with Teflon™ PTFE NXT.

Permanent Deformation of Teflon™ PTFE NXT and PTFE
at 500 psi and 100 °C (212 °F)



Product Offering



Teflon™ PFA Resin

Teflon™ PFA is a perfluoroalkoxy copolymer resin available in pellet or powder form. Teflon™ PFA combines the processing ease of conventional thermoplastic resins with the excellent properties of Teflon™ polytetrafluoroethylene (PTFE).

Products manufactured from Teflon™ PFA can offer continuous service temperatures up to 260 °C (500 °F). What's more, Teflon™ PFA provides superior creep resistance at high temperatures, excellent low-temperature toughness, and exceptional flame resistance.

Teflon™ PFA is used for tubing and tank linings, where aggressive chemicals are found, injection parts including pumps and valves, and roto-molding and roto-lining drums.

Teflon™ PFA fluoropolymer resins are processed by conventional melt-extrusion techniques and injection, compression, rotational, transfer, and blow-molding processes. The high melt strength and heat stability of these resins permit the use of relatively large die openings and high-temperature draw-down techniques that increase processing rates.

Products: 340, 345, 350, 411HP, 416HP, 420HP, 440HP, 441HP, 445HP, 450HP, 451HP, 940HP Plus, 945HP Plus, 950HP Plus, 951HP Plus, 959HP Plus, 9738JN, Conductive PFA C980, and C-9000 Series

Teflon™ FEP Resin

Teflon™ FEP is a fluorinated ethylene propylene resin that meets the ASTM Standard Specification for FEP-Fluorocarbon Molding and Extrusion Materials under ASTM Designation D2116-95a. It is available as pellets or stabilized aqueous dispersions. Applications for this family of resins include coating, melt extrusion, and impregnating. Products made from Teflon™ FEP are known for their excellent chemical resistance, superior electrical properties, and high service temperatures of up to 200 °C (392 °F). In addition, Teflon™ FEP provides outstanding low-temperature toughness and unique flame resistance.

Teflon™ FEP fluoropolymer resins are processed by conventional melt-extrusion techniques and injection, compression, transfer, and blow-molding processes. The high melt strength and draw-down capability of these resins facilitate the use of large dies and draw-down tooling to increase production rates.

Products: 9302, CJ95, CJ99, 100, 106, 9835, 9494 and 9898

Product Offering



Teflon™ PTFE

Products made with Teflon™ fluoropolymer resins have exceptional resistance to high temperatures, chemical reaction, corrosion, and stress-cracking. The mechanical toughness, electrical, and low-friction properties of Teflon™ make it the preferred polymer for a host of applications and processing techniques.

Due to their features of superior chemical compatibility and oxidation resistance, Teflon™ PTFE fine powders are ideal for chemical filtration in semiconductor fabrication processes that include etching, cleaning, photoresist, developer and other high temperature, strong corrosive, and oxidative solvents.

Granular Molding Powders

Teflon™ PTFE granular molding powders are ideal for molding many different products and stock shapes, such as rods, tubes, and sheets. Products fabricated from Teflon™ PTFE stock shapes are unaffected by nearly all chemicals and feature superior electrical properties. These products, some of which are rated for continuous service at 260 °C (500 °F), also provide exceptional low-temperature toughness, plus unique adhesion and flame resistance.

Products: 7A X, 7C X, 8A X, NXT 70, NXT 75, NXT 85, and 807N

Lubricated Paste Extrusion

Available in white, often called "fine," powder, these fluoropolymer resins are uniquely capable of being sheared by lubricated paste extrusion into a coherent fibrous matrix with useful structural integrity. Teflon™ PTFE fine powders provide a practical method for producing long lengths of product from a resin that cannot be melt-extruded. Fine powders are being used to make filter membranes.

Products: 6C X, 6CN X, 60 X, 62 X, 62N X, 62XT X, 601 X, 602 X, 605XT X, 613A X, 640XT X, 650XT X, 669 X, 669N X, and CFP 6000 X

Tefzel™ ETFE Resin

Tefzel™ is a modified ethylene-tetrafluoroethylene (ETFE) fluoropolymer available as pellets or powder for rotational molding. Tefzel™ ETFE resin combines superior mechanical toughness with an outstanding chemical inertness ideal for coated stainless steel ducting.

Products: 200, 207, 280, HT2181, HT2183, HT2184, HT2185, HT2195, 750, HT2188, HT2160, HT2170, HT2202, and 2202HS

Complimentary Products



Teflon™ Industrial Finishes

Teflon™ industrial finishes are available in both powder and liquid form. Teflon™ industrial coatings spray on like paint and bake to a tough, inert finish.

Stainless steel ducting for ventilation using a coating with Teflon™ fluoropolymer has been in use in semiconductor manufacturing since the 1990's. Teflon™ industrial fluoropolymers are very resistant to corrosion and chemical attack, resulting in a longer coating life against fouling. Other benefits include less maintenance for end users and lower overall manufacturing costs for molders.

www.teflon.com/industrial

Krytox™ Performance Lubricants

Krytox™ lubricants are non-toxic, long-lasting, multipurpose lubricating oils and greases available in a wide variety of formulations to improve the performance of equipment in your production line. Whether you need safe, effective vacuum pump fluids or superior lubricity for bearings, valves, seals, O-rings, chains, compressors, gearboxes, mechanical pumps, or other components, Krytox™ oils and greases fight friction, seal barriers, and help lengthen the use-life of your equipment, even in extreme high or low temperatures. That means you'll have less downtime and possibly less need for replacement parts less often than when using conventional hydrocarbon lubricants.

www.krytox.com

Nafion™ Ion Exchange Materials

Nafion™ is a perfluorinated ion-exchange membrane that has a wide variety of commercial uses. Chemicals used in semiconductor manufacturing require ultra-high purity. The selectivity of Nafion™ membranes in various electrochemical processes provides ultra-high pure compounds that are cost-effective.

www.nafion.com

Opteon™ and Vertrel™ Specialty Fluids

Opteon™ and Vertrel™ are used to clean the front opening universal pods (FOUPs) that hold silicon wafers in controlled environments. Performance is critical to prevent contamination of silicon chips. Superior and reliable cleaning of FOUPs and flip chips has made Opteon™ and Vertrel™ the solvents of choice in the semiconductor industry. Opteon™ and Vertrel™ are also used as heat transfer fluids in power semiconductors or IGBT modules in high-speed trains and elevator drives. Opteon™ and Vertrel™ provide consistent and reliable performance in these applications. Opteon™ and Vertrel™ also provide superior cleaning and heat-transfer solutions for industries such as MEMS/NEMS.

www.vertrel.com

Viton™ Fluoroelastomers

In the smallest of spaces—amid ultraclean environments, high temperatures, and harsh chemicals—Viton™ fluoroelastomers provide peak performance and resistance. Specified for seals, O-rings, gaskets, doors, and tubes, Viton™ fluoroelastomers outperform the competition.

www.viton.com

The Chemours Company offers a wide array of world-class materials and expert technical support that enable the fabrication of semiconductors with products, including Teflon™ PFA, FEP, and PTFE fluoropolymers for high-purity fluid handling systems, Teflon™ finishes for corrosive fume exhaust linings, Viton™ fluoroelastomers that provide sealing solutions for broad chemical resistance, Krytox™ high-performance lubricants and vacuum pump oils, and Opteon™ and Vertrel™ specialty fluids for etcher/ tester chiller coolant and wafer cleaning/drying.

Headquartered in Wilmington, DE, Chemours is a new company with over 200 years of history, created from the DuPont performance chemicals businesses. Employing 6000+ people and operating in 55 manufacturing and laboratory sites, Chemours is serving customers in over 130 countries with deep, collaborative knowledge in key industries, including semicon, fine chemical manufacturing, and photovoltaics.



130+

countries where Chemours
serves customers

