BRIDGING THE PERFORMANCE GAP: DUPONT™ VESPEL® CR-6110 FOR HIGH-PURITY SEMICONDUCTOR APPLICATIONS

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CURBELL PLASTICS

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The limitations of traditional fluoropolymers and PEEK form a performance gap for applications requiring mechanical performance in aggressive chemical environments.

Due to their performance characteristics, certain plastic materials are widely specified for wet process applications in the semiconductor industry. Among these, fluoropolymers are known to exhibit the highest levels of purity and chemical inertness making them especially popular for critical applications involving extremely aggressive chemical environments.

PTFE, PVDF, AND PEEK

PTFE is perhaps the quintessential fluoropolymer. Besides being the most widely produced (accounting for roughly 60% of the global fluoropolymer production volume), PTFE is generally considered the most chemically-resistant thermoplastic polymer in existence with very few reported interactions up to around 260℃ [1]. Even so, PTFE is not the perfect choice for every application.

For one thing, PTFE exhibits a comparatively high coefficient of thermal expansion (CTE) with abrupt conformational changes around room temperature at 19 and 30℃, respectively. Across this small temperature range alone, PTFE has been found to experience a change in specific volume of around 1.8% [1].

Another potential short-coming of PTFE relative to other plastics is that it is not very strong nor stiff, especially at elevated temperatures. It is also highly prone to creep. Other fluoropolymers like PVDF exhibit heightened mechanical properties, but are still significantly less strong and stiff than higher-performance materials like PEEK (which is not a fluoropolymer). For comparison, select properties of PTFE, PVDF, and PEEK are included in Table 1 on page 4.

Table 1. PTFE, PVDF, and PEEK Property Comparison

Material	Tensile Strength	Flexural Modulus	CTE	Max Continuous Service Temperature (in air)
PTFE	3,000 psi	72,000 psi	8.9 x 10^{-5}/°F	500°F
PVDF	7,800 psi	310,000 psi	7.1 x 10^{-5}/°F	302°F
PEEK	14,000 psi	590,000 psi	2.6 x 10^{-5}/°F	480°F

Source: Typical properties taken from Curbell Plastics website [2]. Not for specification purposes.

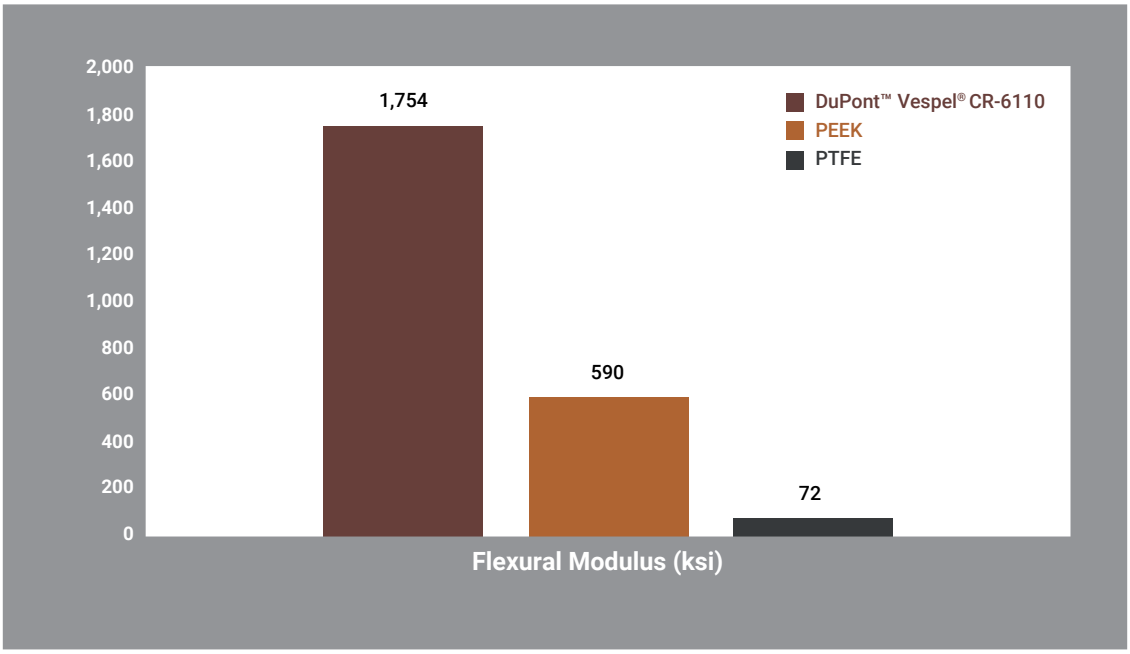
Despite its mechanical advantages, PEEK is less broadly chemically-resistant than its fluoropolymer cousins. Notably, sulfuric acid, nitric acid, and other strong acids tend to react with PEEK resulting in its swift and significant degradation.

DUPONT™ VESPEL® CR-6110

The limitations of traditional fluoropolymers and PEEK form a performance gap for applications requiring mechanical performance in aggressive chemical environments. DuPont™ Vespel® CR-6110 is a carbon fiber-reinforced PFA composite simultaneously offering comparable chemical inertness to PTFE and strength and stiffness properties in its x-y direction beyond that of unfilled PEEK.

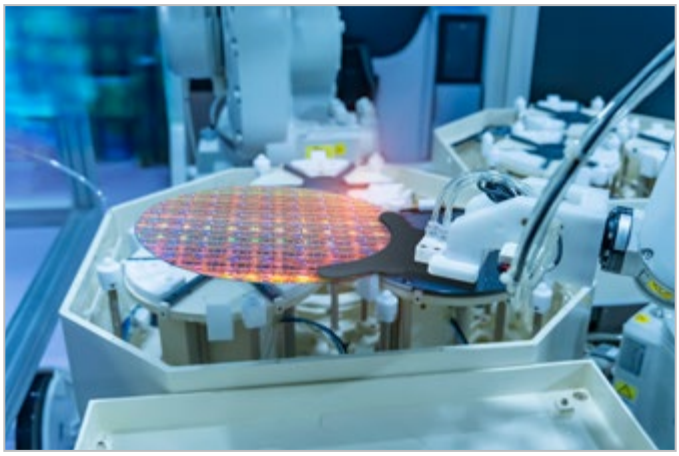
For comparison, the flexural moduli of Vespel® CR-6110, PEEK, and PTFE are shown in Figure 1 below.

Figure 1. Flexural Moduli of DuPont™ Vespel® CR-6110, PEEK, and PTFE



Source: DuPont, 2010 [3]. Typical properties only. Not for specification purposes. The flexural modulus of DuPont™ Vespel® CR-6110 is reported in the x-y direction. Z-direction properties will differ and should be considered during design.

DuPont™ Vespel® CR-6110's unique combination of properties creates opportunities for enhanced part performance in both wet process applications and high temperature environments. As it was specifically formulated for semiconductor applications, high purity standards are maintained throughout the manufacturing process. Notably, Inductively Coupled Plasma Mass Spectrometry (ICP-MS) analyses have shown metallic ion extractables below parts per billion levels [4].



DuPont™ Vespel® CR-6110 can reduce preventative maintenance costs in wafer cleaning operations.

Initial application successes include thermal insulators and bearings in elevated temperature semiconductor applications as well as various components used in the clamping and handling of wafers, such as clamping pins, screw components, and even spin chuck surfaces. It is also gaining popularity for use in valve components.

CONCLUSION

Bridging the performance gap between fluoropolymers and PEEK has long been a pipe dream. With DuPont™ Vespel® CR-6110, we now have a new option for those applications requiring both the load-bearing capabilities of PEEK and the chemical performance of PTFE. It'll be exciting to see what new application challenges this material will help solve in the near future.

ABOUT AUTHENTIC DUPONT™ VESPEL® SHAPES

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[1] Ebnesajjad, Sina. *Fluoroplastics, Volume 1*. 2nd ed., Elsevier, 2014, p. 10, 33, 410.

[2] "Plastic Properties Table." *CurbellPlastics.com*, Curbell Plastics, Oct. 2025, https://www.curbellplastics.com/resource-library/material-selection-tools/plastic-properties-table/.

[3] *DuPont™ Vespel® CR-6110 Chemically-Resistant Shapes for Electronic Applications*. DuPont, 2010, p. 1.

[4] *DuPont™ Vespel® CR-6110 For Wet Semiconductor Applications*. Dupont, 2025, p.4.

TECHNICAL EXPERTISE

Curbell white papers are intended to provide engineers and designers with basic information about the engineering polymers available as sheet, rod, tube, and film stock from Curbell Plastics. We invite you to contact Curbell via e-mail at **technicalsupport@curbellplastics.com** to discuss applications in detail

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For more than 80 years, Curbell Plastics has been one of the nation's leading providers of polymer sheets, rods, tubes, and films, as well as fabricated parts, adhesives, and prototyping materials. Our customers range from small local businesses to large *Fortune* 500 companies and government agencies. We partner with organizations in dozens of industries, including aerospace, pharmaceutical, machinery manufacturers and sign fabricators. At Curbell, we understand the unique demands of each market and we have the expertise to help you meet your business needs. Whether your objective is to reduce manufacturing costs, improve productivity, or increase product reliability, Curbell can help.

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Dave Seiler is Senior Business Development Manager for Curbell Plastics focusing on high-performance engineering plastics. Dave has an extensive background in polyetheretherketones and handles Curbell's DuPont™ Vespel® product line outside of the West Coast. His work involves helping companies identify the best plastic materials for their applications in order to achieve quality improvements and cost savings.

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