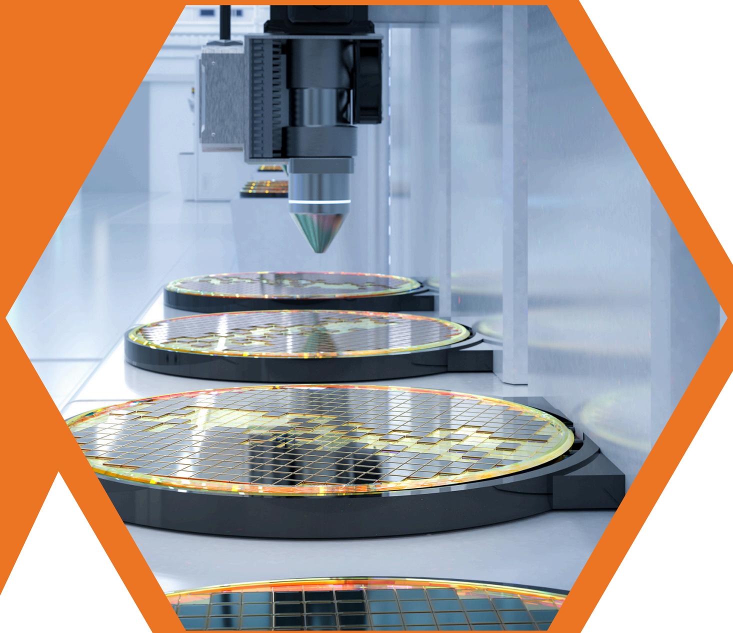

CASE STUDY

PARTICLE-CONTROLLED COATINGS FOR SEMICONDUCTOR WAFER CONTACT APPLICATIONS

OVERVIEW

A European automation specialist supporting a semiconductor application required a PTFE coating for aluminium parts that would come into direct contact with semiconductor wafers. While low friction and non-stick performance were essential, the defining requirement was far more stringent: the finished coated surface had to remain free from any particles that could damage sensitive wafer structures.

This requirement shifted the project from a standard coating enquiry to a surface integrity and contamination control challenge, where it was not just the performance of the coating material but the performance of the final surface that was critical.

THE ENGINEERING CHALLENGE

The parts were aluminium components, under 320 mm in size, with coating required on the functional faces only. In service, the coated surfaces would interact directly with semiconductor wafers, where even extremely small particles could interfere with sensitive features or cause scratching. Any particles above 10 microns were considered unacceptable. After ascertaining that the requirement was not for a cleanroom coating environment but for particle-size control on the final coated surface we set about finding a solution.

The challenge was not just to apply a PTFE coating with acceptable tribological properties but to ensure that coating chemistry, application method, cure cycle, substrate condition, and post-coating handling all worked together to produce a surface that would be safe in direct wafer contact.

OUR APPROACH

The enquiry was approached as a **process engineering problem,** rather than a simple material substitution.

Our material scientists evaluated how different coating routes could influence particle generation and retention. The selection of a PTFE-based system was maintained but not treated as the sole determinant of performance. Instead, attention was given to how the coating would be applied, how it would cure, and how the resulting surface would behave under inspection.

A smooth, low-energy, and defect-free surface was required to resist adhesion and wear, reducing the amount of particulate matter created during operations along with a high hydrophobicity and oleophobicity, allowing for easier cleaning and the prevention of contamination build-up, maintaining the surface below critical cleanliness thresholds.

Substrate condition was also considered a critical factor. The parts were aluminium 5083, with anodising present, but the customer required options for whether the coating would be applied to the existing anodised parts or raw material. This would directly affect surface topography, adhesion, and the likelihood of particle entrapment or release.

Rather than moving directly to production, the proposed route included technical validation steps and the option to produce sample parts to ensure that performance could be verified under real conditions before scaling.
Handling and packaging were treated as part of the engineered solution. Since contamination can be introduced after coating, controlled handling and protective packaging were defined as necessary to preserve surface integrity through to final use.

THE SOLUTION

Fluorocarbon developed a process-led PTFE coating solution tailored to semiconductor contact applications.
The solution combined a fluoropolymer coating system with a controlled application and post-processing methodology, designed to minimise particle generation and maintain surface cleanliness below the required threshold. It incorporated:

1. Selection of an appropriate PTFE coating system for low-friction, non-stick behaviour
2. Evaluation of application methods to reduce particle formation and surface defects
3. Consideration of substrate condition to optimise adhesion and minimise contamination risks
4. Defined inspection and validation routes to confirm particle-size compliance
5. Controlled handling and packaging to preserve the coated surface after processing

By treating the coating as part of a complete system, rather than a standalone solution, the approach addressed both functional performance and contamination control.

WHY FLUOROCARBON

In semiconductor applications, failure is rarely caused by the coating material alone. It is driven by how that material is applied, how the surface behaves, and how it is handled before use.

By identifying surface particle contamination as the true risk, we focused on the end condition of the component, not just the coating specification. This enabled a solution that aligned with the realities of wafer-contact applications, where micron-level defects can determine performance.

For contamination-sensitive applications, Fluorocarbon applies a structured engineering methodology that extends beyond coating selection.

By integrating material science, process design, validation, and handling, Fluorocarbon delivers coatings that perform reliably in demanding environments, not just coatings that meet specifications.

ADDITIONAL SEMICONDUCTOR CASE STUDIES

Precision Components for Semiconductor Wafer Carrier Trays

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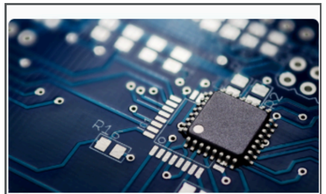

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Flanged Spring-Energised PTFE Rotary Seal for Semiconductor Load Cleaner Application

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