Mitsubishi Chemical Corporation: Engineering the Materials Behind Semiconductor's Next Leap

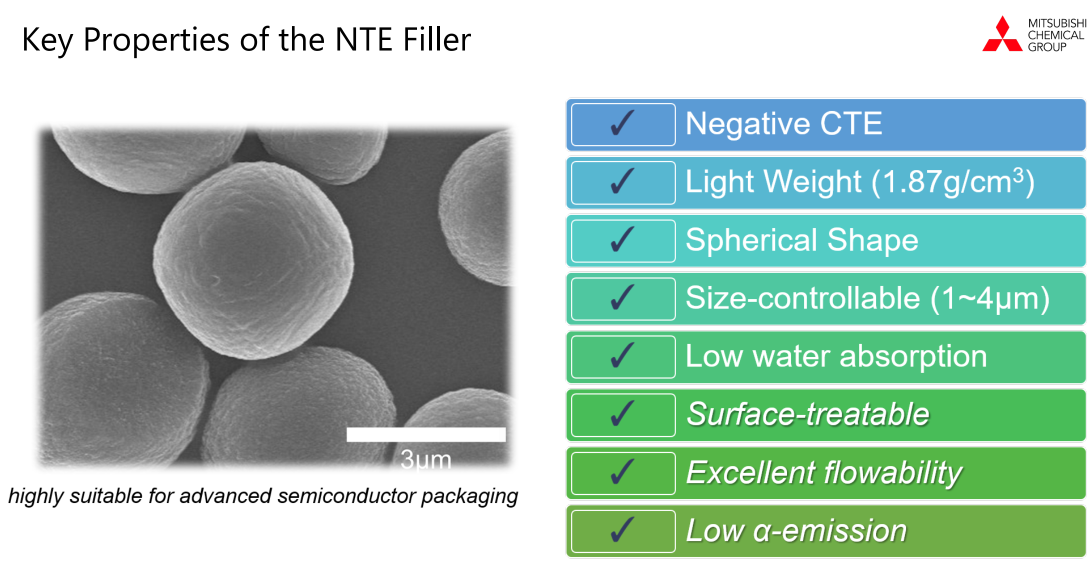
As the industry converges on Taipei for SEMICON Taiwan, Mitsubishi Chemical Corporation is spotlighting three material science breakthroughs — a negative thermal expansion filler for advanced packaging, a record-setting Si/SiGe selective wet etchant for backside power delivery, and a next-generation metal oxide dry resist for High-NA EUV — that show why materials innovation is now the decisive front in semiconductor progress.

Every era of semiconductor advancement has been defined by a bottleneck somebody had to solve. Today, as chiplets, 3D stacking, backside power delivery (BSPDN), and High-NA EUV push devices past the limits of traditional design, that bottleneck has moved to the materials layer.M Mitsubishi Chemical Corporation and its specialty materials company Gelest — is stepping into that space as an innovation partner shaping the industry's roadmap.

Breaking the CTE–Viscosity Trade-Off

Thermal mismatch between silicon and the epoxy encapsulants that protect it is a leading cause of package warpage. The standard fix — packing in more silica filler to pull CTE down — has run out of road: higher loading means higher viscosity, and viscosity too high to flow into a hybrid-bonded stack's microscopic gaps.

Mitsubishi Chemical's answer, presented at ECTC 2026 in Orlando, is a novel negative thermal expansion (NTE) filler — a spherical particle that contracts as it heats, lighter than silica with high circularity. Initially held back by elevated viscosity, the filler was transformed through surface treatment with glycidoxypropyl trimethoxysilane, which sharply improved resin affinity and unlocked excellent flowability. Treated filler achieved a CTE of 26.2 ppm/K — lower than silica — while flowing cleanly through a 50 µm gap, with a Lucas–Washburn capillary-flow simulation matching experimental data closely.

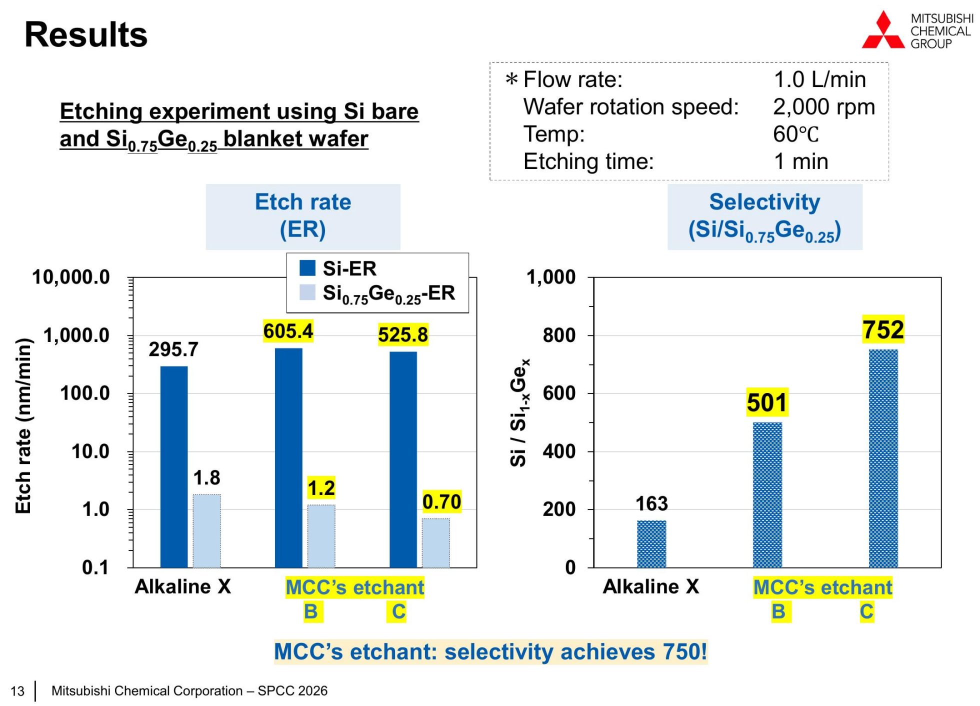


The result: a low-warpage filler platform purpose-built for next-generation chiplets and 3D-stacked logic.

Solving Selectivity for Backside Power Delivery

BSPDN, moving from imec's roadmap into production planning, requires grinding a wafer down to a thin silicon layer on a SiGe etch-stop — a step that only works if the wet etch removes silicon while leaving SiGe untouched.

Presented at SPCC 2026, Mitsubishi Chemical's new alkaline wet etchant does exactly that. Where conventional chemistries top out around 160:1 selectivity, Mitsubishi Chemical engineered a chemistry suppressing Si-Ge surface dissolution while preserving a high silicon etch rate — reaching a selectivity of 752.



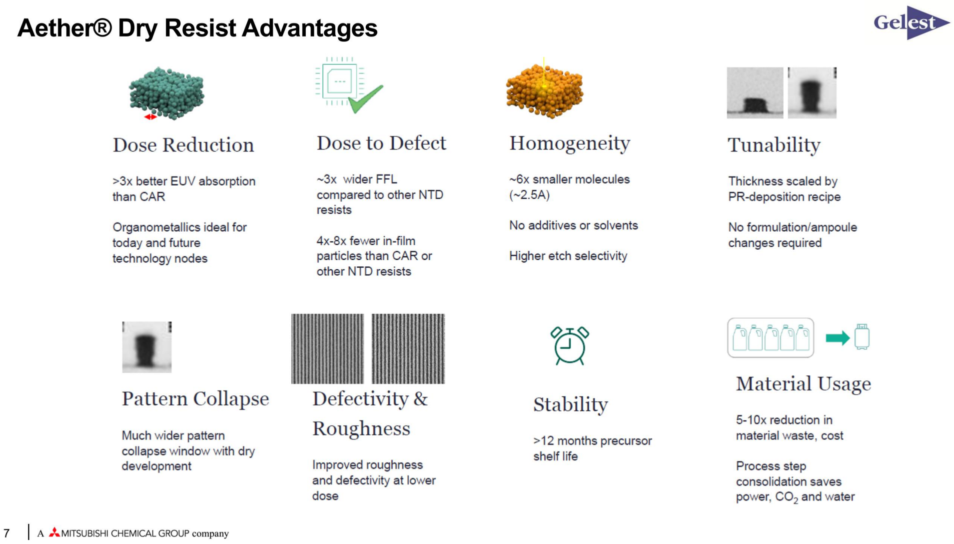
Etch rate and selectivity results: MCC's etchant achieves Si/Si0.75Ge0.25 selectivity of 752, versus 163 for a conventional alkaline etchant.

Validated on a 12-inch single-wafer spin tool, the etchant delivered smooth, low-defect surfaces with confirmed uniformity, and TEM cross-sections showed the SiGe etch-stop intact even after intentional overetch. High selectivity held at lower Ge fractions too — exactly where the industry is headed as etch-stop layers thin.

A Dry Resist Built for High-NA EUV

The third breakthrough tackles High-NA EUV lithography, the enabling step toward sub-2nm nodes. Presented at SPIE Advanced Lithography + Patterning 2026 by Gelest — a Mitsubishi Chemical Corporation company — with Lam Research, this work makes the case for tin-based metal oxide resist. Tin offers one of the highest EUV absorption cross-sections of any element, but manufacturable resists have meant choosing between defect-prone spin-on formulations or organometallic precursors that are notoriously hard to purify.

Gelest's dry metal-organic resist platform, developed for next-generation EUV lithography and enabled on Lam Research's Aether® delivery system, creates a compelling performance advantage. The gains compound: over 3x better EUV absorption than chemically amplified resist, roughly 3x wider focus-exposure latitude, 4–8x fewer in-film particles, a wider pattern-collapse window, and a 5–10x reduction in material waste.



Gelest's Dry Resist Advantages: dose reduction, dose to defect, homogeneity, tunability, pattern-collapse resistance, defectivity/roughness improvement, stability, and material usage reduction.

Solving tin chemistry's decades-old purity problem required ^{119}Sn NMR, achieving parts-per-million sensitivity in 30 minutes. The platform is now ready for commercialization, while next-generation formulations tested on Lam Research's Aether® platform have demonstrated dose reductions of up to 46%. Backing it: a new 50,000-square-foot manufacturing expansion in Morrisville, Pennsylvania, with an ISO Class 7 cleanroom built to scale High-NA EUV precursor supply.

Materials as the New Competitive Edge

All three results echo a theme from NVIDIA's recent Japan ecosystem showcase, where Mitsubishi Chemical joined RIKEN, AIST, Mizuho and the University of Toronto in an AI-accelerated quantum chemistry workflow for next-generation photoresist design — proof the group's ambitions span packaging, etch chemistry, dry resist, and molecular discovery.

As device architecture outruns geometric scaling, the companies that control the chemistry are setting the pace for the industry. At SEMICON Taiwan,Mitsubishi Chemical Corporation is making the case that it belongs in that group: an innovation partner engineering the materials that turn next-generation roadmaps into manufacturable reality.

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