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NOVATI TECHNOLOGIES FOCUSES ON DIVERSE APPLICATIONS

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"Today our mission is to rapidly get our customers into production. We don't make the most complex chips, but we integrate them to deliver the highest system performance."

John Behnke, CEO of Novati Technologies

Much of today's leading-edge semiconductor development is being done, not by using the most advanced design rules, but by integrating disparate chips to meet system-level performance goals. Often done in the vertical dimension, this heterogeneous integration is now among the core competencies of Austin, Texas-based Novati Technologies, a relatively small company with outsized importance in the 3D development field.

In a sense Novati, which operates in a facility that was the original Sematech research fab, is a continuation of the Sematech legacy of developing new technologies. While Sematech was a research consortium that shared its R&D with its member companies, Novati works with individual customers on development and low-volume manufacturing, and closely guards its customers' intellectual property.

John Hamma, vice president of sales and marketing at Novati, said the Sematech activities were largely aimed at transistor scaling, or "More Moore," while Novati more often works on "More Than Moore" customer projects. "Novati is focused on developing novel architectures and materials to improve system-level performance rather than transistor-level performance," he said. Complementing 3D integration, Novati's technology targets include MEMS sensors, microfluidics for medical applications, III-V transistors, and photonics.

The line between More Moore and More Than Moore can be fuzzy. Novati develops solutions using various 3D approaches, including the Ziptronix wafer-bonding approach now offered by Invensas Corporation, a Tessera subsidiary. Novati is the sole US-based commercial foundry licensee and owns the former Ziptronix facility in Morrisville, North Carolina—a 5,000-square-foot rapid prototyping facility that includes bonding, wafer thinning, and pick-and-place capabilities.

Hamma said stacking memories in order to reduce latency, or deploying III-V materials in photonic devices, for example, are ways to boost performance without scaling the gate length of the MPU.

To meet those goals, Novati recently bought a set of Applied Materials 200mm tools—including electroplating, PVD, and CMP equipment—to create what Novati claims is the world's most advanced capability for 2.5 and 3D integration.

The tools also further Novati's ability to integrate III-V and III-n materials with silicon for various applications, including GaN on silicon for high-performance transistors, InP for quantum wells, lasers and multiplexers, and others.

"This kind of integration requires a specialized set of processes and tooling. It pushes the limits of what the Applied tools can do with materials that have very different etch and polish rates. The work we have done with Applied Materials is instrumental in taking, for example, a leading-edge 300mm CMP process onto a 200mm platform and enabling heterogeneous applications," Novati CEO John Behnke said. The effort is in line with the DARPA[1] Cosmos program tagline "The best junction for the function," which is meant to symbolize the advantage of heterogeneously integrating high-performance III-V transistors with high-density CMOS.

Behnke said improving the equipment set at the fab will help Novati "solve the hardest 2.5D and 3D integration challenges, and then produce them in an ISO-qualified, DMEA Trusted facility. The company has been investing substantially in both equipment and manufacturing systems to support future production volume growth."

Unlike the Sematech days when the work focused on research and stopped short of production, Behnke said that "today our mission is to rapidly get our customers into production. We don't make the most complex chips, but we integrate them to deliver the highest system performance."

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NOVATI BACKGROUND

After Sematech decamped for Albany, New York, in 2008, the fab was run as a development facility by Silicon Valley Technology Corporation (SVTC), which had spun out of the Cypress Semiconductor R&D organization. SVTC had facilities in both Silicon Valley and Austin, but went out of business, some-what abruptly. That left one of its customers, Tezzaron Semiconductor, in a serious bind, because it had just won a major defense-related contract that called for its low-latency stacked-memory solution to be made at the SVTC Texas facility. Tezzaron bought the Austin fab in late 2012 and created a stand-alone subsidiary, Novati—a name derived from the word in*novati*on.

Tezzaron uses its proprietary "SuperContacts" contact-level TSV technology to connect what it calls "dis-integrated device architectures." It has focused its stacked memory-plus-I/O solutions on supercomputing, military, and other high-performance applications.

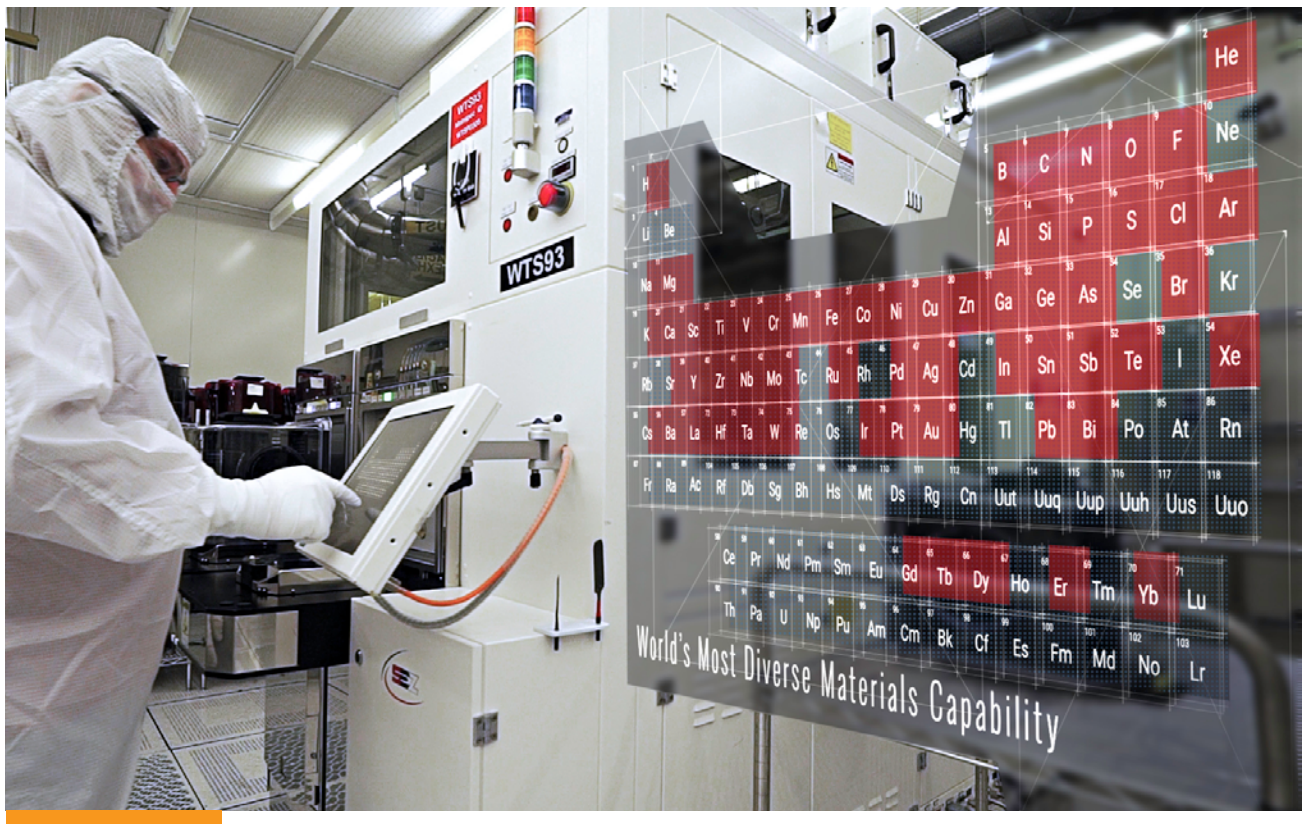
While both Tezzaron and Novati are focused largely on 3D integration, Novati is operated as a separate subsidiary, independent of privately held Tezzaron. Novati is profitable, has increased to more than 100 staffers, and predicts approximately 12% revenue growth this year and next, said Patrick Meyer, Novati's senior director of finance and business operations.

A COMPLEX BUSINESS MODEL

Behnke said one of Novati's biggest challenges is running a fab where there are many diverse demands competing for equipment time simultaneously: development projects amid other high-mix, low-volume production runs. Many of their tools can be quickly switched between 200mm and 300mm configurations in order to support both requirements.

A staff that has experience switching among multiple products provides Novati an advantage over other low-volume production competitors. "When you try to run so many things in a small facility, to effectively keep all the scheduling up to date, you can't do it in a traditional sense. You have to have the right tools, the right operational software, the right market focus and staff. It is the combination of those things that has allowed us to become successful," Behnke said.

Novati is accredited by the Defense Microelectronics Agency (DMEA) as a Trusted Foundry, and many of its customers



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are in the aerospace and defense sector. "We are the only Trusted fab currently doing 3D for government clients in a meaningful way," said Behnke. While details are not forthcoming for security reasons, he noted that "we can do a variety of things at the system level in detectors and imaging-type components. We don't build the CMOS imager itself, but by improving the coupling to the read-out circuitry we can dramatically improve the performance of that sensor. And we have government customers interested in that performance boost, in areas where their technology needs are well served by our capabilities."

INVENSAS PARTNERSHIP

Craig Mitchell, president of Invensas, said his company has prototyping capabilities that enable customers to collaborate with Invensas to further develop and optimize their bonding platforms for specific applications. Beyond prototyping, Mitchell said "it's critical to be able to demonstrate these processes on high-volume manufacturing equipment." That is where Novati comes in, with the equipment investments it has recently made.

The Invensas ZiBond and DBI bonding approaches are in wide use for backside illuminated (BSI) image sensors, Mitchell said, and are poised to "broadly proliferate into other markets, such as MEMS, RF, DRAM, and various 2.5D and 3D integrated circuit applications."

In MEMS, for example, customers are working to use bonding techniques for multiaxis, multifunction MEMS devices. The manufacturing processes must achieve high hermeticity, a low thermal budget, and "ultimately, reasonable manufacturing costs," Mitchell said. "Working with Novati, we are in the process of demonstrating these benefits to our customers."

Marketing executive Hamma added, "It is all part of Novati's mission. Our customers want to improve system-level performance, not necessarily by speeding up the MPU, but by improving latency or by increasing the absolute density of memory, reducing power usage, reducing parasitic capacitance that can contribute to noise—things that don't require Moore's Law scaling to address, but are solvable through better system-level integration."

For additional information about Novati visit www.novati-tech.com

[1] Defense Advanced Research Projects Agency