

Integrated Materials, Inc. Company Fact Sheet

Company Overview

Integrated Materials, a silicon science and technology company, is dedicated to advancing semiconductor manufacturing through improved technologies and processes. Its SiFusion™ technology enables the first pure poly silicon furnaceware, a breakthrough solution for front-end thermal processes.

Company Headquarters

1169 Borregas Avenue
Sunnyvale, CA 94089

Market Overview

As the semiconductor industry moves to smaller geometries, fabs face pressures to maintain the high performance standards set by IC customers. The materials traditionally used to construct furnace consumables – quartz and silicon carbide – are the source of much of the wafer's defects and contamination. Defect detection and removal for years has been the fab's only opportunity for furnace process improvements. Defect prevention, through use of poly silicon fixtures, opens the door to new levels of throughput for advanced integrated circuit manufacture.

Technology

Integrated Materials' expertise and intellectual property on the science of silicon includes 14 U.S. and four international patents for its SiFusion technology. This innovative technology enables the successful manufacture of semiconductor-grade furnace fixtures from poly silicon – the purest commercial material in the world. Integrated Materials is the first and only company to do this.

Product Portfolio

Integrated Materials' complete line of poly silicon SiFusion furnaceware includes boats, injectors, liners, pedestals, ring boats and shelf boats.

Applications

SiFusion furnaceware is ideal for use in all vertical furnace applications in 200 mm and 300 mm environments. Thermal processes include LPCVD, amorphous silicon, high temperature oxidation (HTO), and other high-temperature processes up to 1350°C.

Global Reach

Headquartered in Silicon Valley, Integrated Materials has a global network of sales and support representatives to service customers locally.

Worldwide Support Offices:

Asia

Japan
Korea
Singapore
Taiwan

Europe

France
Germany
Italy
Switzerland

United States

Texas
California

Financing

Privately held. American River Ventures led the last round of financing in November 2005 with investments from existing investors Alloy Ventures, Labrador Ventures and Rocket Ventures.

Contact

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SIFUSION

the future of furnaceware™

www.sifusion.com

SiFusion™ Technology for Pure Poly Silicon Furnaceware by Integrated Materials, Inc.

With SiFusion, Integrated Materials introduces pure poly silicon furnace fixtures, resulting in reduced particle defects and improved yields.

For years, semiconductor process engineers have wrestled with the acute problems of particle defects in IC manufacturing. While engineers have coped with current defect rates in 200 mm processes, these rates cannot be tolerated in 300 mm, given the demanding characteristics of advanced IC device processing.

Vertical furnace processes, including high temperature diffusion, deposition and rapid thermal processing, comprise up to 30 percent of the major process steps in wafer manufacturing. In these processes, particle defects are caused by properties inherent to traditional quartz or silicon carbide (SiC) furnace consumables, including the boats, liners, pedestals and injectors. Quartz and silicon carbide furnace consumables have been the only source material options for the last 20 years; consequently, most IC makers do their best to minimize these defects, but see them as unavoidable.

While recent improvements in furnace cleaning have helped to remediate particle defects induced by quartz or SiC consumables, engineers still have not achieved the overall reduction of defect rates required for state-of-the-art manufacturing environments. Moreover, the cleaning process itself is costly in terms of cleaning chemicals and environmental safeguards.

Now the SiFusion™ patented process by Integrated Materials Inc. perfects the use of poly silicon as the source material. Integrated Materials has developed the first proven application of poly silicon furnaceware as an alternative to current quartz and silicon carbide consumables. The suite of SiFusion products includes furnace boats, liners, injectors and pedestals. These products are designed for furnaces from the major capital equipment suppliers, Tokyo Electron (TEL), Kokusai, ASM, Aviza and others.

Poly silicon is elemental silicon in a non-oriented crystalline form. Unlike single crystal silicon, polycrystalline silicon is a high-strength, structural material with excellent high-temperature stability. Unlike silicon carbide, it is non-porous and non-absorbing, making it ideal for extremely high furnace temperatures because its Coefficient of Thermal Expansion (CTE) matches that of the wafer. Additionally, poly silicon's elemental purity is measured in parts per billion and parts per trillion, compared to quartz and silicon carbide, which are measured for purity in parts per million.

SiFusion furnaceware is appropriate for thin film (LPCVD – silicon nitride and polysilicon), high temperature (anneal/drive), oxide and other furnace applications in both 200 and 300 mm environments.

Addressing the Challenges

Poly silicon furnaceware provides the solution for the perennial challenges of reducing particle defectivity and streamlining production costs in wafer fabrication. With the use of SiFusion technology, IC manufacturers can make substantial gains against these issues.

LPCVD Processes

• Reduce Particle Defectivity

In typical high temperature processes, deposition film accumulates on the furnace fixtures, creating thermal stress between the films and the fixtures. This stress leads to fractures in the film. The resulting particle generation from these fractures is a major contributor to defect density and has a negative impact on yield.

Pure poly silicon SiFusion furnaceware has a unique surface treatment that virtually eliminates flaking and peeling, and thus reduces particle generation. This special surface finish provides a strong mechanical adherence between the deposited film and the poly silicon fixture surface. As a result, poly silicon furnaceware has demonstrated up to an 80 percent reduction in particle defects compared to silicon carbide.

• Eliminate Routine Cleaning

Defect density specifications set by IC manufacturers drive the stringent cleaning cycles for traditional quartz and silicon carbide consumables. For example, newly installed quartz towers may be used for 17 to 34 cycles before particles exceed limits, and customers must remove the fixture for cleaning. This process is time-consuming and results in significant furnace downtime.

By comparison, SiFusion poly silicon furnaceware requires no routine cleaning, thus minimizing downtime and its associated productivity losses. Moreover, by not needing cleaning chemicals, wafer fabs save the costs of purchase and their disposal, which reduces its environmental footprint.

In LPCVD applications, SiFusion furnaceware has demonstrated cumulative deposition of 120 microns without routine cleaning. These fixtures are still in use for deposition today without cleaning.

Diffusion Processes

• Lower Trace Metal Contamination

The wafer manufacturer's goal of a perfect wafer surface with very low crystal-originated particulates or pits (COPs) requires wafers to be annealed in hydrogen at temperatures above 1200°C. Hydrogen, however, causes metallic impurities in both quartz and silicon carbide to become quite mobile and, if present in the furnace fixtures, to diffuse into the wafers. Because SiFusion furnaceware is made from the same material as the wafer, it can have holes, chips and cracks without contributing any impurities. SiFusion technology significantly reduces trace metal contamination — two to four orders of magnitude less metal contamination than high-purity quartz or silicon carbide. In fact, poly silicon furnaceware is clean to $<1.0 \text{ E}10 / \text{cm}^2$ for all trace metals.

• Avoid Slip

Crystal damage or "slip" due to differences in CTE between furnace fixtures and the wafer is an ongoing challenge for high temperature processes. Slip is caused by thermal shock or vibration of a heated crystal lattice. The motion of the heated silicon wafer against any portion of the supporting fixture has a high probability of causing crystal lattice damage. The result is a series of crystal defects in the wafers that can damage the devices located in the defective area. In contrast, SiFusion furnaceware matches the wafer's CTE, eliminating slip and improving yield.

Slip in high temperature processes is particularly problematic with quartz consumables, which can warp or sag in vertical furnace applications. While improvements in design have increased the number of process cycles before quartz warps, they have not eliminated the problem.

• **Maintain Structural Stability at High Temperatures**

SiFusion furnaceware survives severe temperature cycling and performs without deformities in demanding processes that reach temperatures of up to 1350°C. This characteristic enables increased thermal ramp rates and reduced thermal stabilization times. SiFusion technology's thermal shock resistance means fixtures maintain their mechanical tolerances at temperatures far above normal furnace processes.

In addition, poly silicon furnaceware is transparent to infrared, which reduces thermal "shadowing" and allows for more uniform heating within the hot zone.

• **Achieve Precision Manufacturing Tolerances**

Poly silicon's properties permit precision manufacturing tolerances that make for a more efficient robotic interface that can reduce wafer load and unload time.

SiFusion Technology in the Fab

SiFusion technology mitigates previous challenges in manufacturing pure poly silicon furnaceware, and Integrated Materials, Inc. has successfully entered into long-term evaluation programs with a number of semiconductor manufacturers and is already the Tool of Record with one major U.S. fab. Aviza Technology recently selected SiFusion as the designed-in component for a major 300 mm diffusion furnace order.

About Integrated Materials, Inc.

With its patented SiFusion™ technology, Integrated Materials, Inc., Sunnyvale, Calif., is the first and only company to perfect the poly silicon furnace fixtures solution sought for years by the semiconductor industry. Integrated Materials' unique family of SiFusion poly silicon furnaceware eclipses traditional quartz and silicon carbide consumables by its ability to increase yield by reducing particles in LPCVD as well as trace metal contamination and slip reduction in high temperature processes. SiFusion furnaceware improves productivity and reduces cost with the elimination of routine cleaning. Already qualified by 200 mm and 300 mm key fabs, SiFusion products are tested, proven and available now. Integrated Materials is supported worldwide by its team of application engineers and in-country support staff.

Contact an Integrated Materials representative at:
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