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Silicon-on-Diamond Wafers Enable Transistor-Level Thermal Management

SANTA CLARA, CA — sp³ Diamond Technologies, Inc. (sp³), supplier of wafer scale diamond and diamond products for solving thermal management challenges in high-performance applications, announces a revolutionary new approach to thermal management in the semiconductor industry: silicon-on-diamond (SOD) wafers. After thorough research, sp³ has developed a proprietary chemical vapor deposition (CVD) process to deposit highly uniform diamond thin films onto large-diameter substrates up to 300mm. A thin layer of silicon is then deposited onto the diamond layer to provide design engineers with a known interface on a thermally conductive substrate.

sp³ SOD wafers provide a new level of thermal management in the semiconductor industry. The benefits of diamond, including its thermal conductivity and ability to be metallized, enable many new micro- and nanofabrication applications, including MEMS and traditional III-V devices. The SOD process is leading to a commercial scalability that is very difficult to achieve with other substrates, such as silicon carbide. sp³ large area deposition reactors are able to produce single 300mm SOD wafers, which represent state-of-the-art for CMOS processors, or multiple 100mm wafers, which represent state-of-the-art for gallium arsenide (GaAs) or gallium nitride (GaN) power devices.

Thin-film diamond heat spreaders are proving to be a cost-effective material for thermal management in advanced semiconductor applications. The 2005 International Technology Roadmap for Semiconductors (ITRS) has identified SOD as a notable materials-based thermal management approach. Traditional wafer scale materials, such as silicon (Si) or Silicon-on-Insulator (SOI), can be a major bottleneck for thermal management of junction temperature in advanced electronic devices. SOD reduces junction temperatures due to increased thermal conductivity, and offers lower current leakage similar to alternative substrates, such as SOI. For instance, it has been demonstrated that the thermal rise of a 1.5µm Si device layer with input power of 223mW can be as much as 150°C after 20 minutes on an SOI substrate. The same Si device on top of a SOD substrate at 500mW of input power will rise only 40°C.

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“SOD wafers were developed specifically to address thermal management issues resulting from the trend towards smaller geometries and more powerful electronic devices,” commented Dwain Aidala, President of sp³ Diamond Technologies. “sp³ has years of experience in growing and applying diamond, dating back to the company’s roots in diamond-tipped cutting tools. SOD wafers are the latest example of providing design engineers with a cost-effective and production-ready thermal management solution.”

About sp³ Diamond Technologies, Inc.
sp³ Diamond Technologies provides diamond-based solutions for electronics thermal management, diamond-on-silicon applications, and enhanced cutting surfaces. Based in Santa Clara, California, USA, the company provides diamond products for thermal and cutting applications, diamond deposition services, hot filament CVD reactors, and deposition consulting services to companies worldwide across a broad spectrum of industries.

sp³ Diamond Technologies is a subsidiary of sp³ Inc., a full service provider of products and services relating to thin-film and freestanding diamond deposition and other diamond materials. sp³ Inc. is comprised of sp³ Diamond Technologies and sp³ Cutting Tools.

For more information about the company and its products and services please visit www.sp3inc.com.