Advantage

Modern Microsystems' epitaxial transfer approach enables use of diamond with the highest thermal conductivity without the high-thermal-resistance seed layers necessary for growth of diamond on GaN or growth of GaN on diamond. Modern Microsystems has demonstrated 3x areal power density improvement over GaN-on-SiC.

Value

Modern Microsystems' process results in GaN-on-Diamond wafers that are compatible with existing GaN-on-Silicon-Carbide (GaN-on-SiC) RFIC foundries. No additional capital is required by semiconductor manufacturers to use the new wafers.

Modern Microsystems' low-temperature epitaxial transfer process avoids the introduction of thermal bow and warp associated with direct growth of GaN on diamond or diamond on GaN, enabling bow and warp requirements to be met.

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Modern Microsystems

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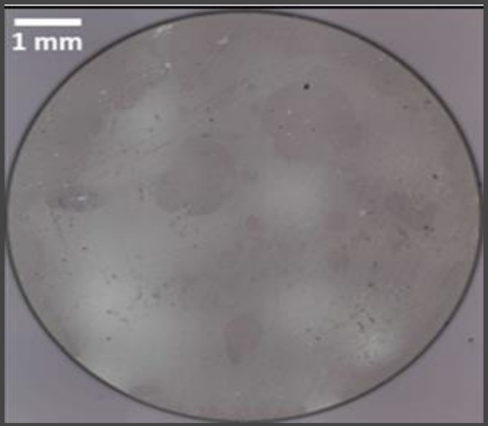
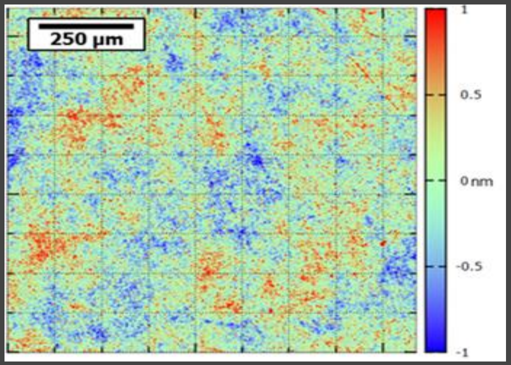


Optical micrograph of GaN-on-Diamond substrate

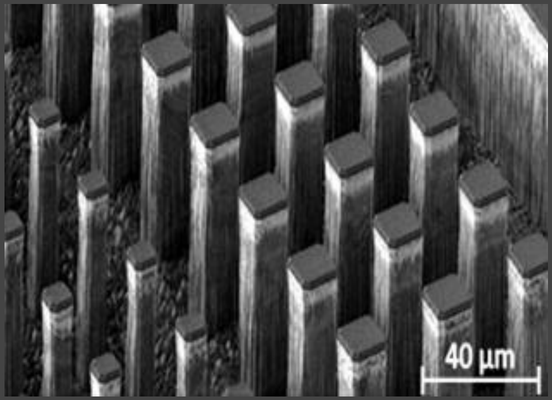
Modern Microsystems, Inc. provides research and development services. The Company develops new products and processes in life sciences, physical, social sciences, and engineering.

Modern Microsystems Inc.
Gaithersburg, MD, USA

"The Best Diamond with the Best GaN"



Interferrometric micrograph diamond surface



Array of high-aspect-ratio diamond micropillars fabricated by deep reactive ion etching

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Modern Microsystems Inc.

Gaithersburg, MD, USA

Company History

A full-service microfabrication R&D firm founded in 2008 with core IP in diamond microfabrication.

High-power gallium nitride (GaN) electronics in radar and electronic warfare systems are thermally limited. GaN-on-Diamond wafers speed heat extraction for improved device reliability, increased power capability, reduced size, and lower cost. Modern Microsystem's wafers are plug-compatible with existing fabrication lines.

Mission/Vision Statement

Leveraging life sciences, physical, social sciences, and engineering to develops innovative products and processes

Competencies

GaN-on-Diamond by Epitaxial Transfer

- Accommodates high-thermal-conductivity polycrystalline diamond and high-quality GaN from SiC epitaxy
- Enables selection of GaN and diamond precursors.
- Optimizes cost vs. performance for each application.

Semiconductor-Quality Diamond Polishing

- Reduces nanoroughness, microroughness, waviness, bow, and warp.
- Applicable to all diamond substrates, including large-grained poly
- Improves best commercial polish by an order of magnitude.

Diamond Deep Reactive Ion Etch

- Through-wafer etch capability.
- Mask selectivities exceeding 300:1
- Etch rates up to 1 µm/min.
- Aspect ratios of 20:1 or greater.
- Optics, microfluidics, vias, backgrinding, and singulation

Diamond Crystallographic Etching

- Smooth sidewalls and sharp corners.
- Extreme aspect ratios greater than 100:

Diamond Isotropic Etching

- Smooth hemispherical etch pits

Enabling wider trade space among reliability, size, and performance for new capabilities in future military systems

Market/Customers

Clients include government agencies, prime contractors, university labs, and independent tech companies

Contract Vehicles

Department of Energy: High-Aspect-Ratio Diamond Refractive Optics Phase II SBIR 05B: X-Ray Optics Technology for Light Source Facilities: The nation's cutting-edge synchrotron facilities require the most powerful x-ray optics to enable scientific discovery. Modern Microsystems is upgrading existing optics made of toxic beryllium with higher-performing, non-toxic, synthetic diamond lenses

US Navy: Low-Cost Gallium Nitride (GaN) on Diamond Semiconductors for Microwave Power Amplifiers Phase II SBIR: N151-046: A process to manufacturing low-cost, high-quality, GaN-on-Diamond wafers, enabling production of high-power RFICs. Process employs epitaxial transfer, gallium nitride is grown on silicon carbide handle wafers, removed from handles, and bonded to diamond wafers. Modern Microsystems proprietary plasma polishing and diamond bonding technologies ensure GaN-Diamond bond interfaces are smooth, uniform, and strong, with minimal thermal boundary resistance.