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Case ID:M09-035P
Published: 1/25/2011

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Low Temperature Wafer Bonding

Currently, the fabrication of semiconductor devices requires immensely complicated procedures, performed on high quality materials, under extreme conditions. Consequently, the semiconductor industry is constantly looking for improved methods of and superior materials for device fabrication.

Researchers at Arizona State University have nucleated and synthesized a novel group of bonding nanophases (?SilOxSis?) that can perform as a cross-bridging 2-D interphase between semiconductor wafers or 3-D nanophase between nanobeads. SilOxSis has numerous unique properties that can significantly improve semiconductor device fabrication by reducing procedural complexity and mitigating procedural conditions. Specifically, SilOxSis forms under low temperature conditions (room temperature - 200°C). The bond itself withstands a pressure of at least 10 MPa. SilOxSis?s chemical composition comprises only Si, O, and H-doping (with the structure of each specific nanophase determined by the bonded surface combination and processing conditions) making SilOxSis compatible with both Si-based devices and biological applications. Furthermore, nucleation and synthesis of SilOxSis requires chemicals and oven annealing conditions below 200°C that are compatible with standard device, silicate, and ceramic processing and/or sintering requirements. Meanwhile, SilOxSis can also bond with Si-Nitride and Si- Carbide polymorphs as well as Si-Ge-based materials. Also, unlike competing wafer bonding processes, SilOxSis technology minimizes built-in stress between bonding materials and requires no physical deposition or plasma/sputtering/dry etching processing to achieve bonding strength above the breakage point of the materials being bonded. Furthermore, SilOxSis requires no additional wafer transfer to a plasma processing or vacuum system, eliminating the need for extra costly equipment and hardware.

Potential Applications

- Medical Electronic Devices - integrated, single implantable devices (e.g. bio sensors, electronic processors, drug delivery systems, etc.)
- Optoelectronic Devices - photovoltaic encapsulation on glass substrates, improving reliability and cost
- Other applications requiring wafer bonding

Benefits and Advantages

- Eliminates Excessive Strain along the Bond Interfaces - thin bond thicknesses and fully compatible chemical composition transitioning from one wafer to another eliminates built-in strain
- Simplifies the Manufacturing Process - eliminates vacuum processing steps; eliminates the need for extraneous costly equipment and hardware; operates with a low cost, low footprint, all-in-one processing tool; requires no physical

deposition or plasma/sputtering/dry etching steps
- Low Temperature Process (Room Temperature - 200°C)
- Consists of Organically-Friendly Materials - Si, O, H-doping, etc..

For more information about the inventor(s) and their research, please see

Dr. Nicole Herbots' directory webpage

Dr. Robert Culbertson's directory webpage

For more information about related technologies, please see

M11-163P: H2O Nano-Bonding