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Sample Stage/Holder for Improved Thermal Control at Elevated Growth Temperatures

Synthetic diamonds have a variety of applications, ranging from jewelry to semiconductors. One fabrication method, plasma enhanced chemical vapor deposition (PECVD), is ideal for applications that require high purity materials with minimal defects. Diamond growth utilizing PECVD employs a gas mixture of hydrogen, methane, and select dopants. These dopants allow for the creation of p-type and n-type diamonds, which are particularly important for semiconductor applications. However, n-type diamond doping still faces challenges related to reliability, quality, and costs. Therefore, there is a need for modifications to current PECVD systems that enhance the efficiency and effectiveness of diamond doping and synthesis.

Researchers at Arizona State University have developed a new water-cooled sample support for improved thermal control of substrates during the deposition process. The stacked configuration of the sample stage/holder creates thermal interfaces that can be adjusted to achieve a temperature profile suitable for growth at elevated temperatures. The improved thermal control allows for high temperature growth of materials, such as diamonds. By decoupling the substrate surface from the plasma, the soft deposition process creates ultra-smooth, low defect density films. Additionally, this design eliminates the need of an additional substrate heater, which is often a source of impurities that reduce doping effectiveness.

Potential Applications

- Synthetic diamonds
- Mineral growth
- Chemical vapor deposition
- Semiconductors and electronics
- Abrasive materials

Benefits and Advantages

- Increased Doping Efficiency - Eliminates the need of an additional substrate heater, which is often a source of impurities that reduce doping effectiveness.
- Improved Thermal Control – Allows for heating of the substrate by plasma energy while maintaining all other reactor components at significantly lower temperatures.
- Improved Quality - The soft plasma exposure and deposition process creates ultra-smooth, low defect density films.

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

Dr. Robert Nemanich's directory webpage