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Millimeter-wave range operation for diamond transistors

Motivation

Diamond transistors are expected to provide the best performance in high-frequency high-power operation among semiconductors because diamond has high carrier velocity and the highest thermal conductivity. Until recently, our diamond transistors were fabricated on CVD diamond grown on single-crystal diamond substrates whose size is limited to several millimeters, which is the size of commercially available diamond substrates.

Originality

We have succeeded in fabricating diamond transistors on large-area polycrystalline CVD diamond. The highest operation frequency is 120 GHz. Therefore, the devices operate as amplifiers in the millimeter region (from 30 to 300 GHz). They also have high breakdown electric field and excellent heat spreading properties.

Impact

These diamond devices will replace the vacuum tubes now used in the very-high-frequency, very-high-power region, leading to increased output power in communication satellites, television broadcasting stations, and radar.

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