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Coulombic Boson electronics towards room temperature quantum computing

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ABSTRACT

The scientific and technological bottlenecks in the large-scale practical applications of quantum computing are limited by the low-temperature superconductivity approach. An alternative approach is deemed necessary to achieve room-temperature quantum computing. Room-temperature Bose-Einstein condensation (BEC) and superfluidic Boson transport phenomena may serve as feasible alternatives to superconductivity-based low-temperature quantum computing. Recently, numerous optical detection methods confirmed the superfluidic BEC phenomenon in solid-state materials at room temperature. The demonstration of BEC by electrical detection methods and its consequent electronic device applications are yet to be realized due to the low energy and momentum distribution of the energy-momentum-locked BEC signals. For example, the energy distributions of the BEC signal in two-dimensional (2D) van der Waals (vdWs) materials are few meV. Here we discuss, the observation of Bose-Einstein condensation of exciton-polariton hybrid bosonic quasiparticles in MoS_2 at room temperature under ambient atmospheric pressure. Highly efficient FET devices with ultra-low contact resistance (R_C) beyond the current state-of-the-art devices are necessary for the electrical detection of superfluidic BEC signals. Here we introduce a residue-free transfer method which resulted in an ultralow Ohmic contact resistance R_C of ~78 Ω-μm (close to the quantum limit) and a record-high on/off ratio of ~10^{11} in atomically-clean monolayer MoS_2-FET. Such efficient FET along with other technological solutions discussed here, may provide an ideal electrical platform for low-energy BEC signal measurements. If this could provide an alternative solution for a qubit, quantum computing, and quantum information science applications at room temperature, is still an open question and need to be investigated.

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