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High-Temperature Operation of Single-Electron Transistors Based on Single-Walled Carbon Nanotubes

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Single-electron transistors (SETs) are one of the possible devices for use as transducers for highly sensitive sensors that can detect small charges. We describe two approaches to fabricating high-temperature-operable single-walled carbon nanotube (SWCNT) SETs, which can operate above the temperature of liquid nitrogen, with a mass-production-adaptable process. One approach involves a SET with SWCNTs dispersed in a carboxymethylcellulose (CMC)/water suspension, which can improve the SWCNT/metal interface properties by increasing the barrier height, so that Coulomb oscillations can be observed up to 80 K. The other approach involves a SET with a segmented Coulomb island between two higher resistance parts in an individual SWCNT, which were induced by Ar ion irradiation. This SET has been operated at up to 100 K, and the operation temperature could be increased by the improvement in the device structure.

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