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Precisely Localized As-grown Single Walled Carbon Nanotubes for Facile Fabrication of Field Effect Transistor Device

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A single-walled carbon nanotube (SWNT) with small diameter (1-2 nm) is one of the most promising materials for application as an electron transporter, owing to its quasi one-dimensional structure. A carbon nanotube field effect transistor (CNT-FET) having a SWNT as its gate channel has been particularly investigated as a favorable nanoscale device for next-generation electronics [e.g. 1]. However, in most previous reports, SWNTs were dispersed or transported during the device fabrication process, which may induce significant damage and doping of SWNTs. CNT-FET consisting of as-grown high quality SWNTs may be obtained by depositing electrodes on as-grown SWNTs, but fabrication of fine structures (e.g. electrode gap < 1 m) is still challenging.
Recently we succeeded in restricting the catalyst-coating area by patterning a self-assembled monolayer (SAM) on a Si substrate [2]. The growth location in this process can be precisely controlled at sub-10 nm scale. This method has some advantages compared with conventional techniques. Firstly, it is possible to easily prepare substrates using a scalable dip-coating method for supporting catalysts [3,4]. It can also be patterned with high resolution (~10 nm) using the electron beam of a scanning electron microscope (SEM). A back-gate-type CNT-FET with an as-grown SWNT bridge and pre-deposited source and drain electrodes was fabricated. Here we report the fabrication process and measured properties of the device.

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