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Micro-scale "air-gap" circuitry with conducting carbon nanotube-copper composite CHANDRAMOULI SUBRAMANIAM, Technology Research Association for Single Wall Carbon Nanotubes, Central 5, 1-1-1 Higashi, Tsukuba, Ibaraki, 305-8565, Japan, TAKEO YAMADA, DON N. FUTABA, KENJI HATA, Super-growth CNT Team, Nanotube Research Centre, National Institute of Advanced Industrial Science and Technology, Central 5, 1-1-1 Higashi, Tsukuba, — The ability of water-assisted CVD to produce aligned close-packed single wall carbon nanotubes(CNT) with superior thermal and mechanical properties make them ideal materials for use in microelectronics. However, their poor electrical conductivity has been a major obstacle in realizing this. To overcome this, we report the synthesis of conducting CNT-copper composite (conductivity σ=10^5 Scm^{-1}) through a novel organic phase electrodeposition. The conductivity enhancement (10^3 times over CNT) is due to the high, uniform filling of Cu in the aligned CNT matrix. Micro-scale, three-dimensional lithographic engineering of CNT-Cu, involving fully suspended CNT-Cu beams, is achieved for microelectronic applications. Multi-tier CNT-Cu circuits are also fabricated, with the constituent lines separated by air (replaceable with vacuum). This "vacuum-separation" exists in the horizontal and vertical directions providing unique multi-tier "air-gap" circuits. This realization of dielectric-less, air-gap circuits with CNT-Cu is thought to be a breakthrough for developing faster and efficient microelectronic devices.

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