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Scaling Behavior of Carbon Nanotube-based Biosensors Integrated on CMOS Signal-processing Circuits BYUNG YANG LEE, MOON GYU SUNG, DONG JOON LEE, MINBAEK LEE, JOOHYUNG LEE, EUNJU CHO, SEUNGHUN HONG, Department of Physics and Astronomy, Seoul National University, Korea, SUNG MIN SEO, JUN-HO CHEON, HYUNJOONG LEE, SUH-WAN KIM, YOUNG JUNE PARK, Department of Electrical Engineering, Seoul National University, Korea, IN-YOUNG CHUNG, Department of Electronics and Communications Engineering, Kwangwoon University, Korea — We built uniform arrays of carbon nanotube (CNT)-based biosensors via linker-free directed assembly strategy, where surface molecular patterns were utilized to direct the assembly of CNTs onto specific regions of the devices. The sensor arrays were utilized to detect ammonia and Hg^{+} ions with high sensitivity and selectivity, and the scaling behavior of sensor sensitivity was studied by parallel detection of multiple sensors. We found that the scaling behavior of the sensor sensitivity can be explained by the combination of two effects: adsorption of analyte molecules onto CNT surface and the transconductance change of the CNT junctions. Furthermore, 64 CNT-based sensors were integrated with CMOS circuits into a single-die system-on-a-chip for the detection of glutamate, a neurotransmitter, by combining several technological breakthroughs such as efficient signal processing, uniform CNT networks, and biocompatible functionalization of CNT-based sensors.

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