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Correlated breakdown of carbon nanotubes in an ultra-high density aligned array SHASHANK SHEKHAR, MIKHAIL EREMENTCHOUK, MICHAEL LEUENBERGER, SAIFUL KHONDAKER, NanoScience Technology Center and Department of Physics, University of Central Florida, 12424 Research Parkway, Orlando, 32826, USA. — Many proposed applications of single walled carbon nanotubes (SWNTs) require a massively parallel array and selective removal of metallic pathways from the array via electrical breakdown. Since experimental and theoretical studies of individual SWNTs demonstrate that the breakdown is due to Joule heating which occurs at defect sites, a straightforward extrapolation to an array would suggest that the breakdown would occur at random point inside each SWNT. Here we demonstrate that in a densely packed aligned array of SWNTs containing up to 30 SWNT/μm, the breakdown of one of the SWNTs leads to a highly correlated breakdown of neighboring SWNTs, thereby producing a "nano fissure" shaped pattern. We show theoretically that the correlated breakdown is due to the electrostatic field of broken nanotubes that produces locally inhomogeneous current distributions in the neighboring nanotubes triggering their breakdowns in the vicinity of the broken nanotubes. Our results suggest that the densely aligned array works like a correlated solid and have strong implications in the future development of fault-tolerant nano-electronic circuits based on SWNT array.

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