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Quantitative analysis of the oxidation effects on the electrical characteristics of high-purity, large-diameter semiconducting carbon nanotubes JIA GAO, YUEH-LIN LOO, Department of Chemical and Biological Engineering, Princeton University — Many attempts have been made to utilize carbon nanotubes for chemical, biological and gas sensing applications. Previous studies show that adsorbed ozone (O3) on carbon nanotubes can drastically influence their electrical characteristics. On the one hand, ozone act as p dopants; exposure thus leads to an increase in electrical conductivity. On the other hand, ozone readily oxidizes carbon nanotubes; this chemical reaction results in a decrease in conductivity. It remains ambiguous which process dominates and quantitative evaluation of these two effects is lacking. In this study, we elucidate the interaction between ozone and carbon nanotubes by evaluating the field-effect mobilities of polymer-sorted large diameter semiconducting carbon nanotubes based transistors. Upon exposure to ozone, we observe a positive shift in the threshold voltage from -0.7 to 11.7 V and a concurrent decrease of hole mobility from 2.5 to 0.5 cm^2/Vs. Accordingly, the source-drain current exhibits a non-monotonic dependence on ozone exposure time. This dependence reveals that doping dominates the electrical characteristics of carbon nanotube transistors initially. Beyond 3-minutes of ozone exposure, chemical oxidation dominates, resulting in a progressive decrease in source-drain current.

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