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The role of the oxygen/water redox couple in suppressing electron conduction in field-effect transistors PIERRE L. LEVESQUE, Université de Montréal, CARLA M. AGUIRRE, École Polytechnique de Montréal, MATTHIEU PAILLET, FRANÇOIS LAPOINTE, Université de Montréal, BENOIT C. ST-ANTOINE, PATRICK DESJARDINS, École Polytechnique de Montréal, RICHARD MARTEL, Université de Montréal — Much like with organic semiconductor FETs, a characteristic of carbon nanotube based devices has been their almost exclusive p-type character in air. Electron transport can be observed only under certain conditions, for instance devices annealed in vacuum. We investigated the impact of the chemical nature of the substrate and of ambient adsorbates on the field-effect switching behavior of both nanoscale and thin-film FETs. Our study, using carbon nanotubes as the testbed, revealed that the intrinsic material properties are modified when an adsorbed water layer containing solvated oxygen is present on the SiO_2 surface and lead to the reduction of n-type conduction. This finding demonstrates that an electrochemical charge transfer reaction between the semiconducting channel and the aqueous oxygen redox couple is the underlying phenomenon governing the suppression of electron conduction in these devices. This effect should be considered when measuring the transport properties of nanostructures such as nanowires, organic materials, nanotubes, graphene conducted on SiO_2/Si substrates.

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