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Graphene and carbon nanotube field-effect transistors: environmental effects and light emission properties

**Abstract:** Graphene and carbon nanotube field effect transistors (FETs) are extremely sensitive to gas exposure. Charge transfer doping by atmospheric gas is ubiquitous in these devices but not yet understood. By using carbon nanotubes and graphene as testbeds, we investigated the impact of the chemical nature of the substrate and of different gas exposure on the field-effect switching behavior and light emission properties of both nanoscale and thin-film FETs. Our study revealed that electrochemical charge transfer doping involving the water/oxygen redox couple is the underlying mechanism behind many environmental effects in the device characteristics. It also showed that light emission from nanotube FETs can be switched alternatively between excitonic and thermal emission depending on environmental conditions and bias.