Chemical Functionalization for the Selective Placement of Single-Walled Carbon Nanotubes

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Abstract:

Single-Walled Carbon Nanotubes have attracted enormous interest for use as the active channel in electronic devices due to their outstanding transport properties. A major hurdle in the fabrication of such devices is the development of chemical tools to address major processing challenges such as selective placement and separation by electronic type. This work will highlight recent progress in the chemical functionalization of SWCNTs to facilitate selective placement into predefined positions on gate oxide surfaces. SWCNTs are first chemically functionalized with hydroxamic acid terminated organic compound that selectively binds to metal oxide surfaces (i.e. HfO_2, Al_2O_3). Electron beam lithography is then employed to pattern narrow HfO_2 trenches into which the functionalized SWCNTs selectively bind. The surface functionalization is spectroscopically shown to be fully reversible. Once the nanotubes are assembled into the trenches, the molecules are then removed leaving the unfunctionalized SWCNT behind with the same electrical properties as prior to functionalization. This technique allows for hundreds of working devices to be fabricated with high yield. The electrical properties of the subsequent devices are excellent, showing no deterioration of the electrical performance as a result of the placement process.