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NRL Naval Research Laboratory

Carbon nanoelectronics

At a Glance

What is it?

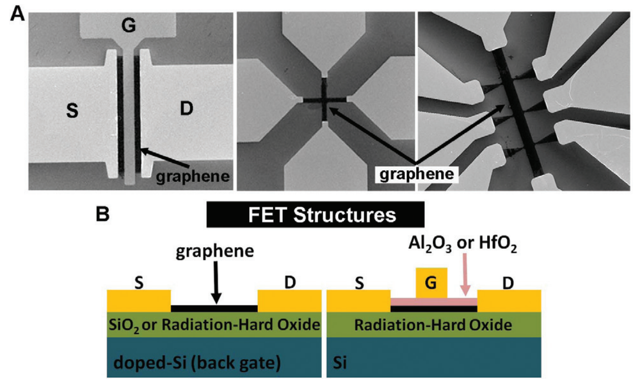
Carbon nanoelectronics are next generation electronics which employ carbon nanomaterials (graphene or carbon nanotubes) as the active electronic component.

How does it work?

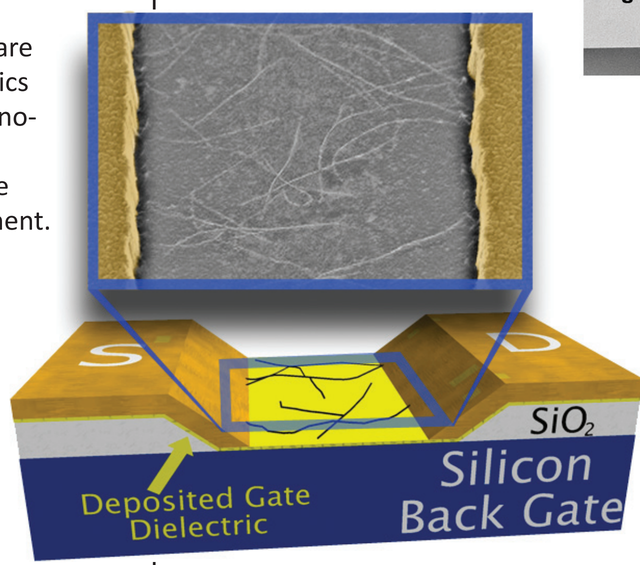
In genenral, the fundamental operating mechanism of carbon-based devices is much like that of traditional Si transistors; they differ because of the unique intrinsic electronic properties of carbon nanomaterials resulting from quantum confinement.

What will it accomplish?

The enhanced electronic properties of carbon nanomaterials establishes thier potential for improved device performance and high radiation tolerance.



Graphene field effect test structures and SEM images depicting the various device geometries



Single-walled carbon nanotube thin-film-transistor schematic and SEM image

The field of Carbon Nanoelectronics rapidly burgeons with breakthroughs in performance and high yield assembly of single-walled carbon nanotubes (SWCNT) and graphene based devices reported almost daily. Such growth is fueled largely by the unique single-atomic layer honey-comb structure of these carbon allotropes, which results in extremely high electron and hole mobilities (potentially in excess of 100,000 cm^2/Vs), extremely high current carrying capability (10^9 A/cm^2), extremely high strength (greater than steel), along with other extreme properties. With the rapid rate of development, carbon nanoelectronics are likely to be used in the near future to boost the performance of electronic systems employed in damaging radiation environments, both terrestrial and space-based.

NRL researchers are currently investigating the effects of such environments on both SWCNT and graphene field effect transistors fabricated at the NRL NanoScience Institute clean room facilities. Recent results indicate that the materials are applicable to radiation environments, but understanding the radiation response and developing strategies to mitigate radiation induced performance variations will be key to deployment in systems of the future.

Research Challenges and Opportunities

NRL is actively seeking motivated students and post-docs to participate in this on-going research effort.

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