

Recent Achievements and Future Challenges in Carbon Science and Technology

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We will first provide an overview of current research challenges and trends in carbon science. The idea is to motivate carbon scientists to discover and synthesize new materials with exciting properties, and to fabricate novel functional devices. In particular, materials with different hybridization states will be discussed. These include 1) sp linear carbon chains, 2) sp²-graphene nanoribbons, 3) sp³-low-dimensional systems (flexible diamonds), 4) three-dimensional (3D) graphene-based structures, and other hybrid systems.

We will also discuss the synthesis of carbon nanotubes and nanotube networks using different dopants during chemical vapor deposition (CVD). In particular, the effects of sulfur, boron and nitrogen during growth will be summarized. It will be demonstrated that it is indeed possible to assemble novel micro-fluidic devices using nitrogen doped aligned carbon nanotubes. These devices can be used to trap and enrich human and animal viruses that could be then identified using different genomic and optical characterization. Most importantly, these viruses are trapped without any label (e.g. antibodies) by tuning the inter-tubular distance within the devices, are viable and could be easily replicated.

This talk will also discuss the synthesis of large-area, high-quality monolayers of nitrogen-, silicon- and boron-doped graphene sheets on Cu foils using ambient-pressure chemical vapor deposition (AP-CVD). Scanning tunnelling microscopy (STM) and spectroscopy (STS) reveal that the defects in the doped graphene samples arrange in different geometrical configurations exhibiting different electronic and magnetic properties. Interestingly, these doped layers could be used as efficient single-molecule sensors in conjunction with Raman spectroscopy. Finally, the synthesis of interconnected graphene layers (graphene foams) by solvothermal routes will be discussed. These foams are highly conducting, very robust and can operate at temperatures ranging from 77K to 1173K.

References

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