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Defect Chemistry of Nanocarbon

YUHUANG WANG, University of Maryland

Defects can rule the properties of a crystal. This effect is particularly intriguing in atom-thick materials such as single-walled carbon nanotubes and graphene, where electrons, excitons, phonons, and spin may strongly couple at the defect sites due to reduced dimensionality. In this talk, we will discuss our recent progress in fundamental understanding and molecular control of sp3 defects in sp2 carbon lattices, and their applications. An sp3 defect (tetrahedral bonding, diamond-like) is created by covalently attaching a functional group to the sp2 carbon lattice (trigonal planar, honeycomb-like) of a carbon nanotube or graphene. The beauty of this type of defect is its well-defined structure and chemical tunability at the molecular level. Our experimental results have unraveled a series of intriguing and surprising roles of defects. Specific examples will be given to illustrate how defects may be used to drive reaction propagation on sp2 carbon lattices, brighten carbon nanotube photoluminescence, and create selective chemical sensors.