The University of Texas at San Antonio

UTSA Physics and Astronomy

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# Characterizing Electronic Structure and Morphology of Novel $sp^3$ Carbon Nanomaterials Using Synchrotron Radiation

Carbon generates rich and diverse classes of nanostructures: fullerenes, nanotubes, graphene, and the topic of this talk, nanodiamond. I will present an overview of our work using various synchrotron-based techniques to characterize $sp^3$ carbon molecules and nanomaterials. We explore how size, shape, bond strain, and chemical functionality affect electronic structure of $sp^3$ carbon molecules and nanomaterials. For example, methane, diamondoids, diamond nanoparticles and bulk diamond, from the smallest to largest $sp^3$ carbon structures, express very different properties and electronic structure. At which sizes do diamond-like characteristics emerge? What happens if we take a molecule containing carbon atoms with four neighboring single covalent bonds, but induce bond strain? This talk will describe what synchrotron radiation is, how it is generated, some of the spectroscopies available, and how such techniques can directly probe electronic structure answering some of these questions in carbon nanomaterials. Our recent work also explores how nanodiamond forms during detonations. We have implemented a capability to perform small-scale detonations at a synchrotron, and using the intense, pulsed x-rays, are observing nanoparticle formation real-time. We compare the real-time morphology information to both detonation models and to characterization of the recovered particulates.

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