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MECHANICAL CHARACTERIZATION OF AMORPHOUS CARBON-NANOTUBE NANOSTRUCTURES BY IN-SITU TEM

Abstract

In-situ mechanical tests of amorphous carbon (a-C)/boron nitride nanotube (BNNT) and a-C/carbon nanotube (CNT) have been conducted to understand the mechanical performance of a-C as a welding material for load transfer between structures in nano-based structural materials. The experiments took place inside the vacuum chamber of a transmission electron microscope with an integrated atomic force microscope system, allowing nanomanipulation simultaneous to real time observation of the hybrid structures. Electron beam induced deposition (EBID) has been used for the deposition of a-C and modification of the structures. The pristine and failed structures were successfully welded with a-C, and a series of tensile, compressive, and lap shear tests were performed on the hybrid structures. The current work presents a-C welding as a viable method for the formation of stable tube-to-tube connections in boron nitride and carbon nanotube bundles and serves as a starting point for the improvement of the mechanical performance of nanotube based materials. Advances in scale-up and bulk production of BNNT and CNNT based composite materials via tube-to-tube load transfer in the base material can greatly benefit space applications, where light-weight/low-budget/high-performance materials are sought after.