Development of Carbon Based Nanostructures

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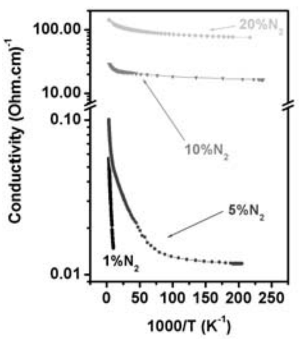
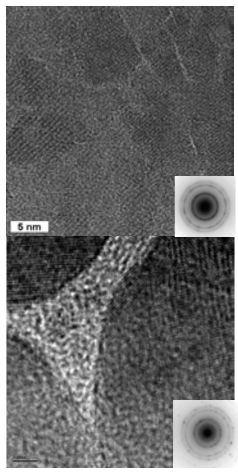
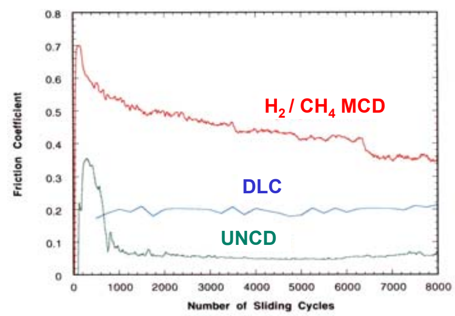
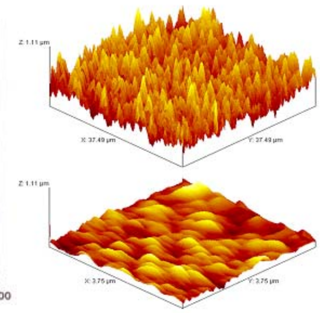
Motivation: Diamond has long been considered an ideal material for a number of advanced applications. One of the major barriers to it's implementation has been the relative lack of control available for depositinf diamond thin films in a number of areas, such as conductivity, film roughness, deposition temperature, and uniform deposition area. This poster details the ongoing work at Argonne National Laboratory toward optimizing and understanding the structure property relationships in ultrananocrystalline diamond (UNCD) thin films, a unique form of diamond thin film consisting of diamond grains 3 – 8 nm across and atomically abrupt grain boundaries. These films possess many of the intrinsic qualities of diamond as well as a number of advantages not available in traditional microcrystalline diamond thin films due to it's unique nanostructure.

The addition of nitrogen at the grain boundaries of UNCD allows for the growth of highly conductive, n-type diamond thin films.

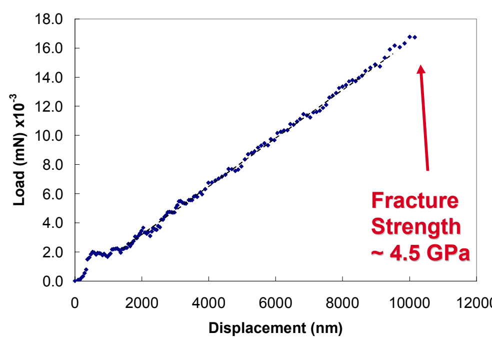




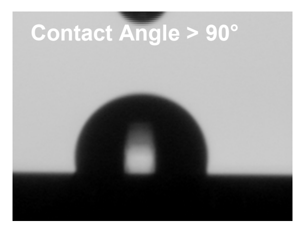




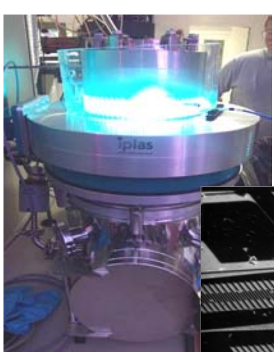
UNCD thin films are hydrophobic, possess inherently low stress, smoothness, and hardness. These are considerable advantages over many other carbon thin films that are potential candidates for MEMS applications.

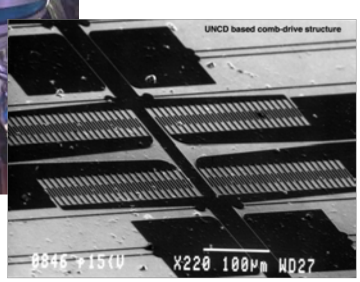


Fracture Strength of UNCD



Impact: The majority of the work in the UNCD program up until this point has been the investigation of the growth process and basic materials properties of UNCD. We have demonstrated that UNCD thin films have a number of superlative properties (high hardness, hydrophobicity, conductive, wear resistance, chemical inertness) that are controllable *in-situ* at the nanoscale that make it a very versatile material for a number of applications.





Future Work: In addition to the other work presented, one of the future goals for the development of UNCD as a viable material for technology is to demonstrate a working UNCD-based MEMS device. A collaboration between Argonne, Sandia National Laboratory, University of Wisconsin-Madison, and Motorola is currently working to determine the most favorable growth conditions, develop large area deposition reactors, optimize the surface termination, and the most efficient fabrication procedures for realizing UNCD-based MEMS devices.

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