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DEPARTMENT OF ENERGY

C/ORNL99-0554

**CRADA Final Report  
for  
CRADA Number ORNL 99-0554**

**CHEMICAL AND MECHANICAL CHARACTERIZATION  
OF DIAMOND-LIKE CARBON HARD COATINGS**

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This document has been reviewed and is determined to be  
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**CRADA Final Report**  
**on**  
**CRADA No. ORNL99-0554 (SMAC Rapid Action Project Proposal)**  
**with**  
**ASTEX - PlasmaQuest (Partner)**  
**for**  
**Chemical & Mechanical Characterization of Diamond-like Carbon Hard Coatings**

**Principal Investigators:** David B. Poker

**Collaborators:** Chris Doughty (Partner)

**Abstract**

This CRADA was intended to investigate and optimize the process used by ASTEX-PlasmaQuest for deposition of diamond-like carbon films. Approval for funding was delayed, and an unexpected move of the PlasmaQuest headquarters and research facilities prevented appropriate samples from being prepared before the end of the CRADA. Therefore, no effort was expended under this program.

**Statement of Objectives**

The objective of this CRADA was to investigate and optimize the process used by the partner to deposit thin films of diamond-like carbon. The hardness of the resulting films is sensitive to deposition parameters, which requires measurement of the hardness to optimize processing conditions. In addition, the partner proposed to use fluorination of the films' surfaces to improve friction and tribology, and measurement of the final fluorine concentration to provide valuable information for optimizing the process.

**Benefits to the Funding DOE Offices's Mission**

The benefit to the funding office would be an improved process for the deposition of diamond-like carbon, which is an effective material for producing an extremely hard surface, effectively reducing wear and friction. More widespread use of these films would result in significant savings in cost and energy consumption in applications such as transportation, machining, and optical coatings.

**Technical Discussion of Work Performed by All Parties**

Analysis techniques proposed for this effort were nanoindentation hardness measurements to determine the correlation between surface hardness and deposition parameters, as well as elastic recoil scattering measurements of hydrogen concentration and distribution throughout the films. Fluorine nuclear reaction analysis was proposed for measurement of fluorine concentration and depth distribution in the films.



While this program was initially proposed to start in June 1999, final approval and funding was not completed until the middle of August. By that time, ASTEX-PlasmaQuest had initiated a move of its corporate and research headquarters from Texas to Massachusetts. The resulting disruption of the research program made it impossible to obtain samples for evaluation before the expiration of the CRADA. Therefore, no effort was expended under this program.

**Inventions (Made or Reported)**

None

**Commercialization Possibilities**

None

**Plans for Future Collaboration**

ASTEX-PlasmaQuest intends to continue collaboration with the ORNL Surface Modification and Characterization Research Center through its user program.

**Conclusions**

The inability to obtain samples for analysis and evaluation under this program prevents any conclusions from being drawn concerning the optimization of deposition techniques for these types of films.

**Distribution:**

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