LA-CRADA--96-4

DIAMOND TECHNOLOGY FOR PARTICLE AND SOFT X-RAY DETECTORS .

Final Report

CRADA Number : LA92C10059

A. Parties

This project is a relationship between Los Alamos National Laboratory (LANL) and Crystallume, Inc.

B. Project Scope

The primary objective of the work is to develop and commercialize a new class of diamond film radiation detectors. To meet this objective, we first optimized the growth process of the diamond films for detector applications. Then we used the optimized diamond films to develop electrode structures that optimize detector performance for specific applications. This was accomplished by designing novel interdigitated electrode structures that enhanced the detector's response to specific particle (or photon) energy, improved detector sensitivity, minimized response time, or optimized other useful characteristics. Finally, we developed multi-element devices with controlled active depths for use in x-ray and particle spectrometry and in position-sensitive (or imaging) detectors.

C. Technical

There have been several significant developments within the CRADA research. The first and foremost is that the understanding of the CVD diamond film's produced by the industrial partner has been greatly extended. Based on the improved understanding, next generation of the diamond films have been grown and will be examined during the remainder of FY95. The second is that devices which can monitor radiation dose-rates, where silicon devices fail, has been developed and became a part of Crystallume's product line. The third is that soft x-ray detectors with detector sensitivities approaching that of silicon x-ray photodiodes that are also solar-blind with the high potential for Inertial Confinement Fusion (ICF) applications have been developed. We have shown that the detector sensitivities are constant within 5-10% over a wide soft x-ray spectral range. We have demonstrated for the first time that a CVD diamond position sensitive detectors can be produced with a spatial resolution of 12 μm or better.

Much of the uncharted territory of diamond radiation hardness has been explored. Measurements were done using various charged particles, neutrons, and photons. All measurements indicated that diamond appears to be 2-3 orders of magnitude more radiation hard in comparison to silicon.

Electrical quality of CVD diamond at present is about a factor of 4 better than single-crystal natural diamond. This will enhance the forementioned detector performance in the future without any design changes. These devices are ready for any market that are in need of these detectors.

D. Partner's Contributions:

The partner's contributions was the iterative growth of CVD diamond films used for detector development. These films were evaluated by us and when suitable used to fabricate detectors. Improvement of film quality resulted from the interplay between growth, characterization and device fabrication.

All deliverables were met. Moreover, a radiation dose monitor was developed which is now a part of Crystallume's product line.

No subject inventions were created during this CRADA project.

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E. Documents/Reference List

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Text:

The research work performed under this CRADA is described in the attached pre- and reprints.

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