Y/AMT-486

Y-12

OAK RIDGE
Y-12
PLANT

LOCKHEED MARTIN

Project Accomplishment Summary
for
Project Number 93-MULT-044-C1-04

ENGINE SYSTEM ELECTRONICS FOR HIGH-TEMPERATURE AND HIGH-VOLTAGE ELECTRONICS, MATERAILS, AND COMPONENTS FOR UNDER-HOOD APPLICATIONS

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FOR THE UNITED STATES
DEPARTMENT OF ENERGY

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DISCLAIMER

PROJECT ACCOMPLISHMENT SUMMARY

Title: Engine System Electronics for High-Temperature and High-Voltage Electronics, Materials, and Components for Under-Hood Applications
Project Number: 93-MULT-044-C1-04
CRADA Number: Y1292-0156
Partner: General Motors Corporation

BACKGROUND

Automotive ignition systems have been in production for many years and have evolved into dependable low cost systems that generally perform as required. Future requirements for automobile ignition systems will however be more demanding as increased energy efficiency and reduced emissions are anticipated. The development of high efficiency, high performance ignition systems are dependent on improved materials and manufacturing procedures. This advancement requires support from materials specialists, high-energy physicists and electrical engineers, all of which exist at the DOE facilities in Oak Ridge.

DESCRIPTION

The purpose of the project was to develop the technology needed to build the next family of automotive ignition systems while improving the performance and reliability of the ignition systems presently in use. This was accomplished by learning from the industrial partner where the state of the art stood and understanding the problems that needed to be solved before fundamental advancements could be made. Then, resources from the DOE facilities were matched to the challenges presented by the industrial partner. The role of the industrial partner was to describe the state of the art concerning the manufacturing and performance of automotive ignition systems to organizations at the DOE facilities. The role of DOE facilities was to apply basic research and development techniques to the problems presented by the industrial partner while advancing the capabilities available to DOE Defense Programs.

BENEFITS TO DOE

During this project, researchers at the DOE facilities in Oak Ridge gained valuable knowledge about epoxy based encapsulation materials and techniques used in the manufacture of high voltage automotive ignition coils. Advancements in high voltage coil encapsulation materials and techniques were then developed in Oak Ridge and tested by the industrial partner. Additionally, ceramic insulator material and forming techniques were also advanced during this project. Both of these technologies are used in the production of weapon systems and are therefore valuable to the DOE Defense Programs.

As a separate task within this project, an energy delivery measurement system was developed that allows for the stable measurement of energy delivered to a spark gap. This measurement is valuable in assessing the efficiency of the ignition system so that performance can be optimized. The equipment and techniques used to make the stable energy measurement have been reported as a possible invention and are being considered for a DOE patent application.

ECONOMIC IMPACT

To my knowledge, the industrial partner will be incorporating some of the coil manufacturing techniques developed in this project in a new coil that will be manufactured as soon as next year (1997). Coil evaluation techniques developed during this project have already been used to optimize the production of coils now being produced. These improvements will primarily be in the form of greater reliability of the ignition system and thus the entire automobile. The monetary impact of such improvements would be difficult to assess because it depends mainly on customer satisfaction and the potential of future sales of domestic versus foreign

automobiles. The cost savings associated with fewer warranty repairs would be easier to quantify, and best estimated by the industrial partner.

PROJECT STATUS

This project was terminated in 1996 when 54% of the project funding had been used.

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PROJECT EXAMPLES

There are test coils manufactured using different techniques that demonstrate the difference in final strength. They may be available from the industrial partner. Also, the first spark plug ever formed with a gelcast was developed during this project and was available for show with the industrial partner's permission.

TECHNOLOGY COMMERCIALIZATION

The improved manufacturing processes developed for ignition coils may be used in the future by the industrial partner. At the time this project was canceled, no formal commercialization had been developed to my knowledge.

Spark plugs formed by the gelcast process had the potential of being mechanically and electrically tougher than conventional spark plugs. This would be very desirable for future high efficiency engine applications where high voltage and limited space are encountered. The new gelcast process also generated less manufacturing waste, which would possibly reduce the spark plug cost. At the time this project was canceled, further development of the manufacturing process was needed before the gelcast process could be used for commercial manufacture.