

## ***Refractory Paints for High Voltage Insulators***

Eltron Research Inc. of Boulder, Colorado is doing research for the Air Force Research Laboratory at Kirtland Air Force Base. The overall goal of this project is to develop refractory coatings that can be used in high voltage plastic insulators that are to be used by the Air Force in pulsed power applications. The paint will have other applications if the coatings are successful in overcoming the problems inherent in this high voltage application. To date we have shown excellent adherence of our ceramic paint to various polymeric materials.

This paint requires only a room temperature cure, is water-based, sprayable, and contains no volatile organic chemicals (VOC's).

### **Purpose and Plan of the Project**

This Phase I program will result in a tough refractory paint that adheres to a variety of plastic insulators with complex shapes creating a strong, adherent, refractory coating with optimal surface roughness. The proposed program targets the properties of the vacuum-insulator interface for high voltage applications and has commercial applications in a wide range of electronic and electrical devices and systems including High Power Microwave tubes and high-energy particle accelerators. Plastic insulators with a thin layer of refractory paint will have increased resistance to surface flashover voltage and improved strength in high voltage applications. The refractory paint developed within this Phase I opportunity will be easily sprayed onto the surface, cured at a low temperature, and adherent to a wide variety of insulating plastics. The surface roughness of the insulator will be optimized by the inherent roughness of the paint. The vacuum outgassing characteristics and durability of the paint during plasma gun discharges will be identified. Since the refractory paint developed in this Phase I program will be sprayed using commercially available paint sprayers to form uniform films, complex shapes will easily be coated.

### **Summary of Work to Date**

In the first months of the Phase I project, methods have been developed for strongly adhering coatings onto high density polyethylene, fluorinated ethylene propylene (Teflon FEP), polyimide (Kapton HN200), and polyethylene terephthalate (Mylar) flat insulator substrates. Coatings have achieved the highest ASTM adherence rating (ASTM D3359-B) of 5B. The coatings have resisted hundreds of spark discharges in vacuum. The aluminum oxide coated polymer insulators appear to possess the insulating and breakdown properties of solid insulators of aluminum oxide, while retaining the lightweight advantages of polyethylene. The adherent paint developed in this program will easily be adapted to create coatings of other ceramic materials to optimize wear resistance, thermal conductivity, and thermal shock resistance.

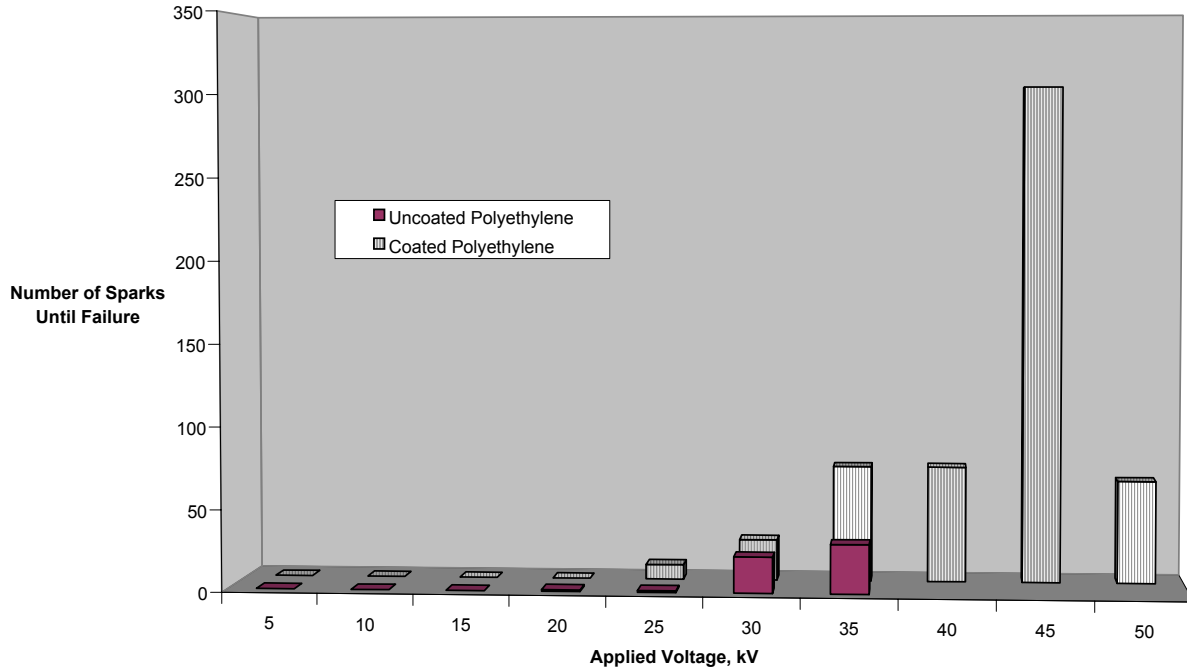
The refractory paint shows excellent adhesion to HDPE after exposure to an Ar/O<sub>2</sub> plasma and an electron beam and protects the underlying polymers from damage.

# TECH BRIEF

(Nonconfidential)



When polyethylene and refractory coated polyethylene are exposed to high voltage conditions, refractory coated polyethylene is able to withstand many more high temperature, high voltage sparks than uncoated polyethylene without loss of adhesion of the refractory coating. The coated polymer insulator behaves much more like a ceramic insulator than a polyethylene insulator. The figure below shows the data.



If you desire any additional information regarding this project or any other Eltron Research Inc. technology, please contact Harold Wright, Vice President – Technology.