Status

At present, the chemical and physical knowledge of model compounds and polymers is much greater than the current understanding of real processable and environmently stable compositions of conductive materials.

Research Proposed

Continued detailed study of model synthetic materials and the physics of these model systems is important for gaining the underlying knowledge for understanding the complicated macroscopic systems. In parallel with this continued study, development of new materials preparation techniques is encouraged. These techniques would include preparation of new forms of composite materials containing conducting and nonconducting polymer systems as well as the formation of polycrystaline or other macroscopic materials formulations.

The broad spectrum of analytical techniques needs to be applied to these model systems as suggested in paragraph 1.2. That includes study of the chemical, crystal and electronic structure as well as the reactivity of the component materials. Detailed physical studies of these model materials need to be performed. This includes measurement of the electronic excitation spectrum of these materials via spectroscopy from the far infared through the vacuum ultraviolet and a detailed determination of the electronic structure or density of states in the vicinty of the fermi level of these materials. Insight into the mechanism of charge conduction in various conductive materials can only be gained through careful coordinated measurements of a broad spectrum of transport parameters including temperature dependent dc conductivity, electrical field dependence of conductivity, the frequency dependency of conductivity from dc through microwave frequencies, the magnetoresistance and Hall effect as well as other related experiments such as thermoelectric power and thermal conductivity. The dynamics of defect states is also an important aspect. Relevant studies includes photoinduced optical effects and photomagnetic effects. In the absence of this broad spectrum of studies an incomplete and inaccurate picture of the electronic structure and properties of these sytems is obtained.

A full study of the electronic properties of the macroscopic formulation of these materials, directly synthesized in the end form, processed as neat polymer or processed in composite form is also warranted. That includes a broad spectrum of transport studies and spectroscopic studies. In addition, the mechanical and rheological properties become more important.