INORGANIC CONDUCTIVE POLYMERS

Scope

From a synthetic point of view, probably the most ignored area in the field of conductive polymers has been that of inorganic chemistry. The lack of effort in this area is quite surprising in view of the myriad of properties available to the inorganic chemist with the use of the transition metals.

In the context of conductive polymers, the use of transition metals offers the following advantages over the conventional carbon based systems. The larger radial extension of the -d- orbitals is likely to result in more favorable bonding interactions resulting in wider band structures and more highly conducting systems. Strong metal-metal bonding in many transition metal complexes as well as the highly conducting tetracyanoplatinates are clear manifestations of this property. In addition, the mixed valence behavior so important to conductive polymers is easily satisfied with transition metals and their multivalence behavior. Systematic changes in the energetics and band filling can be made in a predictable way with the proper choice of transition metal.

Status

Most of the important contributions to the field thus far have included work in the following three areas:

(1) Stacked macrocyclic compounds.

(2) Purely inorganic polymers.

(3) Ordered clusters.

Although much work has been completed in the first category, the central metal in most of these complexes has remained innocent (i.e. not participating in the conduction process). Further work is needed in this area to extend this field to include the heavier transition metals.

$(SN)_x$ and the polysilanes are examples of the second category. Many attempts to extend this work have ended in frustration, however, the initial success with these materials including the superconductivity of $(SN)_x$ provides impetus for further effort in purely inorganic polymers.

The chevrel phases are just one important example of the third category. The chevrel phase, formed from stacked molybdenum-sulfur clusters exhibits low dimensional conductivity at room temperature and superconductivity at low temperature under pressure.

Research Proposal

Intensified research building on what is already known from dimeric and small cluster chemistry is likely to be a fruitful endeavor and greatly enhance this area of conducting polymers.