

STUDIES ON
ORGANIC SEMICONDUCTORS

SUGATA MITRA

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PREFACE

The development of intelligent life on earth, represents perhaps the highest achievement of Nature during the evolution of this universe. It represents the results of millions of years of natural selection. It is, therefore, not at all surprising that the artifacts and devices produced through natural evolution are superior and infinitely more complex than those produced by man over the last four thousand years. Indeed, the Scientist and the Technologist, in their search for new principles, often turn to natural processes for possible answers. A common example is the hypodermic syringe, modelled after the stinging organ of the mosquito. In our search for new materials, therefore, we must keep in mind the materials selected over millions of years by natural processes.

In the development of living organisms, it is startling to note that the elements carbon, nitrogen, hydrogen and oxygen have been chosen almost exclusively out of the 91 non-radioactive elements present on the earth. The living organism is constructed entirely from organic materials. Indeed, the word "organic" was initially used to indicate those chemicals which are present in living systems. The reasons for such a restricted choice of elements is not easy to understand. It has been suggested that the ability of carbon to form long chains of atoms is at the root of this

choice. However, silicon and sulphur which are abundantly present on the earth's crust are also capable of forming such chains. These materials are nearly absent in living organisms. It would, therefore, seem that the infinite variety of organic molecules which can be formed from the elements carbon, nitrogen, hydrogen and oxygen is what facilitated the development of these materials into living cells. Moreover, the brain itself is composed almost exclusively of organic materials, while artificial information processing devices are composed almost exclusively of germanium and silicon. Modern miniaturisation techniques have enabled the construction of circuits containing about 1600 components per square millimeter. The corresponding figure for the brain is likely to be 16 millions. In view of this, it is evident that the functioning of the brain occurs at the organic molecular level, while electronic technology remains at the inorganic crystalline level. However, before an organic molecular electronic technology can be developed, one needs to understand the physics of these complex structures. The need for undertaking a study of organic molecular systems is, therefore, present for both the Scientist, seeking a basic understanding, and the Technologist, seeking new applications.

In the present thesis, we have studied certain optical, electrical and electronic processes in organic molecules and molecular crystals. We hope these elementary studies will help further our understanding of the organic solid-state.

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