MPHYCC-7 ELECTRONICS I

Unit 1: SEMICONDUCTOR

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INTRODUCTION

As a class of materials, semiconductors played, and continue to play, an undeniably pivotal role in the explosive growth of our technical civilization over the last six decades. The main driving force behind this growth was the unprecedented progress in digital integrated circuits (IC) technology as described by Moore's law [1].

During recent years, departure from the pattern noted above can be observed. It is no longer that progress in semiconductor technology is driven solely by technical breakthroughs needed to sustain the growth of digital electronics. During the last ten years, the impact of digital electronics is increasingly accompanied by the accelerated growth of distinct, readily identifiable semiconductor technical domains which are only partially related, or not related at all, to logic and memory IC technology.

The purpose of this overview is to identify and to briefly discuss, in layman terms, selected technologies which are perceived to contribute the most to the recent expansion of priorities which define state-of-the-art semiconductor science and engineering.

To establish a foundation for the follow up discussion, a brief overview of the fundamental properties of semiconductors, key semiconductor materials, as well as their uses is presented. Then, trends in semiconductor science and engineering are discussed and emerging new directions are identified. Subsequently, a discussion of new generation technology drivers is presented, emphasizing the role of organic semiconductors, nano-ordered semiconductor material systems, carbon electronics, as well as photovoltaics, and MEMS/NEMS devices in defining emerging trends. The review is summarized by stressing the critical role semiconductors continue to play in supporting high-tech endeavors of the 21st century.

OVERVIEW OF SEMICONDUCTORS

For the sake of clarity of the forthcoming discussion, it is appropriate to introduce key concepts related to its scope by answering the following three basic questions.

What are semiconductors?

The fundamental electrical property of any solid is its electrical conductivity, i.e. ability to conduct an electric current. As Fig 1 illustrates, insulators and conductors feature very low and very high conductivity respectively, regardless of external conditions such as temperature, or illumination. The electrical conductivity of theses materials, as predetermined by the nature of interatomic bonds which determine electron's freedom to move within a solid, cannot be altered. Metals for instance, can only be very good conductors.

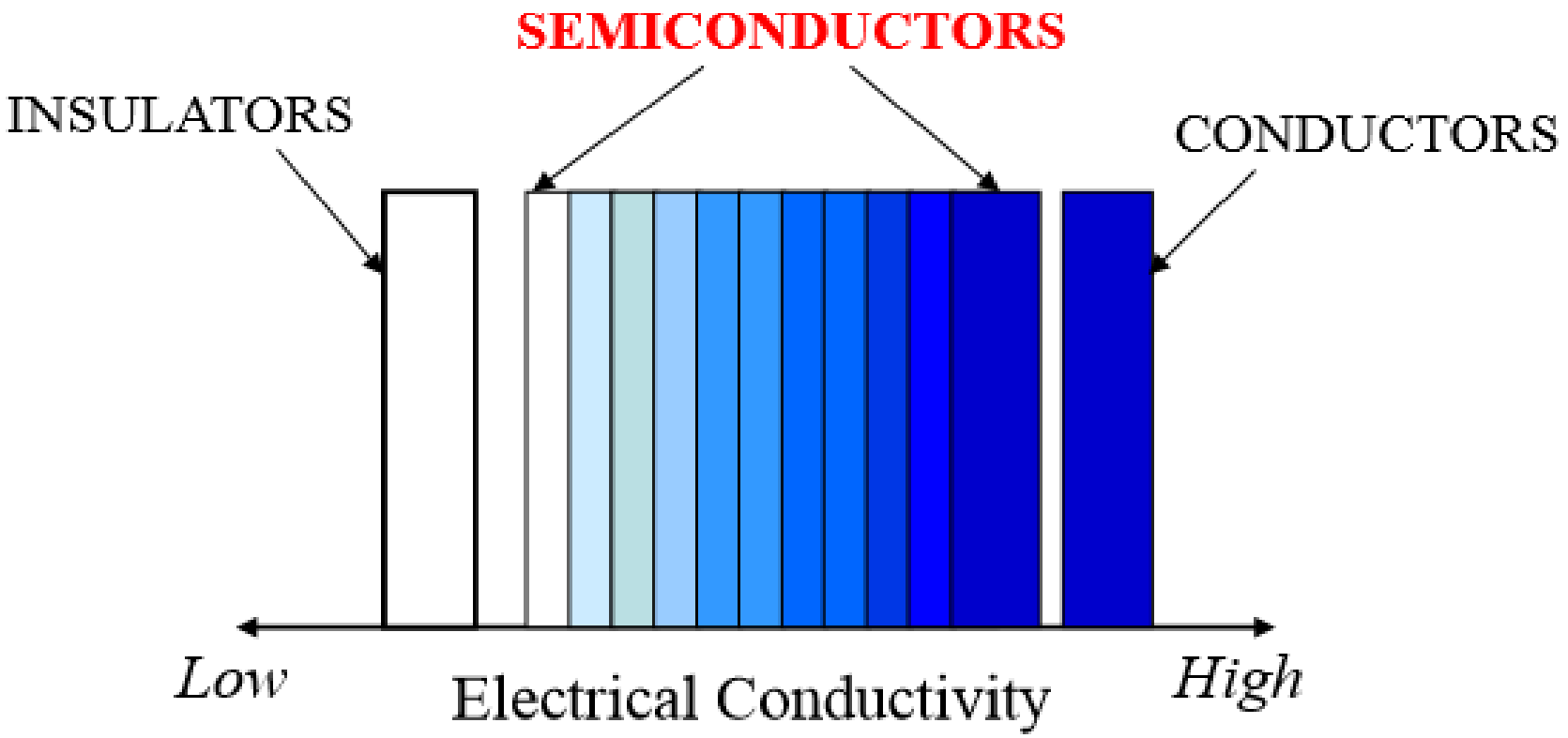

Fig. 1 *Electrical conductivity of solids.*

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Thanks!