Preface

Archimedes said, “Give me a place to stand and I will move the world”. The future technologies based maybe all on light will let as perhaps say: “Give me the light and the world will turn”.

This book gives a personal view on materials science, electronics, photonics and future solar energy devices. Based on the similarities between electronics and photonics and on the new advancements on solar energy and photonics devices, this book tries to expose the new trends in science and future research axis.

If we have materials, light, life and intelligence, we can construct a world. Looking back on the achievements of the last hundred years we remark that on the basis one material: “sand” or “silicon dioxide” the common efforts of human beings led to a huge and unimaginable development. All electronics, informatics and communication networks are based on electronic devices made with silicon which is extracted from sand and optical fibre networks which are fabricated from silicon dioxide.

Materials are constructed from unit building blocks, atoms and molecules, arranged in a periodic structure. In the same way, new artificial unit building blocks, with completely new properties, can be created and new materials called meta-materials or photonics crystals open a huge area of applications and research. The understanding of the basis of solid-state physics allows the understanding of electrons and photons transport phenomena in different 1D, 2D or 3D classical or new periodic structures.

The first chapter of this book presents a parallel between electronics and photonics and the introduction to data transmission.

The second chapter is devoted to theoretical aspects of materials physics including the band energies formation, the charge carrier transport, the photon–electron interactions, quantum wells, quantum dots, photonic crystals and meta-materials. The understanding of band energy formation and charge carriers transport could be subsequently extrapolated for the theories related to photonic crystals, plasmonics, photons interactions and “transport” in periodically optic structures.

As a consequence of photon–electron interactions, the energy of photons can be converted into electrical energy. Chapter 3 describes the fundamentals of solar cells

functioning principles and the new trends in solar cells research giving a non-exhaustive list of examples and strategies developed recently in this research area, in order to increase the energy conversion efficiency.

Chapter 4 is dedicated to the advancements in photonics and photonic devices, including the new materials, the new carriers information vectors (plasmons and surface plasmons polaritons), optical and plasmonics waveguides, lasers, spasers, electro-optical modulators, optical transistors, integrated photonics circuits, etc.

Chapter 5 gives some general considerations on energy and perspectives of a direct use of the solar energy.

This book is dedicated to all physics passionate students and scientists with the hope to give a useful overview on some hot topics at the interface of many research fields such as data transmission, materials physics, nanotechnologies, electronics, photonics and solar energy devices.

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