

# Preface

This book is the result of a productive meeting that took place in Cercedilla (Spain) in 2008 to discuss about new concepts that could be used to improve the efficiency of photovoltaic (PV) devices. Speakers were encouraged to write their contributions and this book is the result of that effort.

The first three chapters review *multijunction* solar cells and the use of *concentrated* light. It is not long ago that multi-junction solar cells were considered as new concepts and now hold the record efficiency over any other photovoltaic device. Proposed by Jackson in 1955 (E. D. Jackson, Trans. Conf. on the Use of Solar Energy, Tucson, 1955, University of Arizona Press, Tucson, vol. 5, pp. 122–126, 1958) they were considered difficult to achieve in practise in 1960 because the use of tunnel junctions was still not considered (M. Wolf, Proc. IRE; Vol/Issue: 48:7, pp. Pages: 1247–1263, 1960). Nowadays, multi-junction solar cells and concentration systems are progressing fast toward industrialization.

Chapters 4 and 5 deal with a topic of common interest for any photovoltaic device as it is *light management*. In particular, Chapter 5 reviews the potential of *plasmon polaritons*. *Light management*, in general, pursues how to absorb more photons in less material volume. This is of interest, not only because the use of less material usually leads to a lower cost of the device, but also because the use of less material reduces non-radiative recombination and therefore increases the efficiency of the device. On the other hand, many of the novel photovoltaic devices, as the intermediate band solar cell, can be regarded as multicolored devices and mastering *light management* is useful to assist photon absorption at those wavelengths where absorption is weak. This mastering often demands dealing with light at electromagnetic level as it is the case of *plasmon polaritons*.

Chapter 6 and 7 deal with *up-conversion* in organic systems and *multiple exciton generation* solar cells, respectively. The first approach pursues converting the absorption of several below bandgap energy photons, not useful for PV conversion, and convert them into a useful high energy photon. The second approach, on the other hand, pursues the conversion of a high energy photon in several lower energy photons. In this way the energy in excess of the photon can be used to create not one but several electron-hole pairs.

Chapters 8–13 deal with the *intermediate band* solar cell concept that pursues the conversion of below bandgap energy photons into solar cell current without voltage degradation. Chapter 8 introduces the concept and the rest of the chapters expand it along different frameworks: modeling (Chap. 9), quantum dots (Chap. 10), thin films (Chap. 11), GaInN (Chap. 12), and ion implantation on silicon (Chap. 13).

Finally, we would like to acknowledge our contributors for their work and patience with the edition of this book, to Springer Verlag for the careful edition of this book, and to all of our families, also in the name of the authors of this book, for the time they have sacrificed of being with their beloved ones.

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