

Preface

Solar cells involving colloidal nanocrystals are a rapidly developing field of research. Many physical and chemical properties of crystalline solids can significantly change when the spatial dimensions of the crystallites are reduced to the nanometer size regime. This opens possibilities to tune material properties in view of specific applications. With respect to thin film photovoltaics, semiconductor nanocrystals have the potential to be used as tunable materials for efficient absorption of sunlight, either in combination with conductive polymer or also in inorganic absorber layers. Thereby, chemical approaches to synthesize the nanoparticles in liquid media give rise to the possibility of producing absorber layers by deposition of the materials from solution. Therefore, similar as in the field of organic photovoltaics, relatively simple and cost-efficient processes like printing technologies may be used for the realization of corresponding thin films.

In the case of organic photovoltaics which itself is a comparably young and still developing field, several books have appeared in recent years, giving good overviews and deep insight into that technology. Approaches to combine conductive polymer with inorganic semiconductor nanocrystals in hybrid systems are sometimes treated as a side-aspect in books on organic photovoltaics or organic electronics, but the literature specialized particularly on solar cells with inorganic nanocrystals is still rare. On the other hand, nanoparticle-based solar cells have made an impressive development in recent years, have their own particularities, and should merit more attention in terms of books focusing particularly on them. This was the main source for my motivation to write the present book.

Research on solar cells with colloidal nanoparticles is strongly interdisciplinary and covers many aspects of physics, chemistry, and materials science. The book aims at bridging gaps between the involved scientific disciplines and collects into one work important fundamentals from different fields. The book reflects the current state of research on relevant materials and different types of nanoparticle-based solar cells. It addresses researchers, Ph.D. students, engineers, and others interested in the application of colloidal nanoparticles in photovoltaics. Moreover, the book may also serve as an advanced textbook to accompany specialized lectures in physics, chemistry, materials science, and related areas.

The book is organized into three parts, the first of them addressing specific properties of colloidal nanocrystals as well as conductive polymer in general. The second part focuses on a selection of characterization methods relevant for the field.

Thereby, short introductions to the different methods are given, and their application potential for exploring the properties of materials and solar cells is discussed. The third part of the book describes different concepts for using colloidal nanocrystals in solar cells and reviews the state of the art and recent developments and tendencies in this research area.

As the author, I would like to express my gratitude to all who supported the writing of the book, either by reading parts of the manuscript or helping me in the planning of the book. Namely, I would like to mention here my wife, Dr. Yulia Borchert, as well as my present, respectively, former colleagues Dr. Martin Knipper, Dr. Marta Kruszynska, Dr. Florian Witt, and Prof. Dr. Elizabeth von Hauff. I am also particularly grateful to Prof. Dr. Jürgen Parisi for his advice in the planning and in whose working group I got the opportunity to perform active research in the scientific field which the present book is focused on. I hope to provide with this book a useful and appealing work and hope the readers will enjoy it.

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