Preface

Within the wide and important field of plasma research, this tutorial book focuses on modern developments in the field of *particle-containing plasmas*. A central issue is the inherent overlap of three key scientific problems of complex plasma physics: *correlations*, *dynamics*, and *reactivity*. Examples include:

1. Coupling effects of highly charged dust particles in plasma traps giving rise to strongly correlated plasma states
2. Dynamics of multispecies plasmas and plasma–surface interaction
3. Chemical processes in plasmas and on plasma boundaries

In this book, these fundamental problems are approached using complementary experimental, computational, and theoretical methods which combine the authors' expertise from plasma physics, surface and solid-state physics, chemical physics, and materials science.

The central goal of this book is to provide graduate students and young researchers with the necessary knowledge base in the fast-growing field of complex plasma research. The style of each chapter is review-like, that is, the authors do not focus only on their own work but also give a survey of the state of the art. For easy access to the various aspects of complex plasmas by newcomers, each chapter opens with an introduction and overview of the particular topic, and also the basics – which are typically not covered in scientific journal publications – are explained in great detail. Furthermore, the chapters are enriched with much valuable background information, which should be of interest to a broad readership.

Part I of this book briefly introduces the very fundamentals of complex plasma physics. This part addresses the key questions and hot topics in modern complex plasma research and links them to the other chapters of this book. Part II is devoted to the field of quantum plasmas and their description with modern simulation techniques. In this part, graphene – the rising star of condensed-matter physics – is introduced as a very recent and promising example for the broad applicability of (quantum) plasma physics. Part III covers strong correlation effects and order phenomena occurring in complex plasmas in traps and introduces powerful numerical methods used for a "first-principle" simulation of dusty plasmas. Finally, Part IV deals with the issue of reactivity and surface processes, which have strong impact for nanotechnological applications.

This book is based on tutorial lectures given at the Graduate Summer Institute on "Complex Plasmas" at the Stevens Institute of Technology, Hoboken, NJ (USA) from July 30 to August 8, 2008. The workshop was jointly organized by the SFB-TR24 "Fundamentals of Complex Plasmas" Greifswald/Kiel (Germany) and Stevens. The school was attended by about 110 participants – scientists and graduate students. The chapters in this book take account of the lively discussions at this summer school and should serve as valuable introductory material for the active field of complex plasmas.

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