

# PREFACE TO THE SECOND EDITION

Although published in 1995 the main body of the first edition was in fact written in 1990. The only exception was the chapter devoted to the one-dimensional nucleation which I wrote two years later during my stay in the National Tsing Hua University in Taiwan. It so happened that in 1989–1990 two new phenomena with great potential for industrial application were discovered — the effect of surface active species (surfactants) on the mode of growth of semiconductor epilayers by Copel *et al.* [1989], and the formation of coherent (dislocation-free) three-dimensional islands in Stranski–Krastanov growth mode by Eaglesham and Cerullo [1900]. In addition, the last decade has seen the beginning of intensive studies of the effect of the additional barrier to down-step diffusion (discovered by Ehrlich more than thirty years ago) on the morphology of growing surfaces. These studies were connected with a dramatic development of the surface analytical tools. As a result of these developments in fact the whole theory of nucleation and growth had to be rewritten taking into account the Ehrlich–Schwoebel barrier.

The idea to update the book taking into account the discoveries mentioned above was the first reason to prepare a second revised edition of this textbook. The second reason was related to the book itself. Many colleagues told me that the book is not easy for reading. Nearly the same number of colleagues told me the opposite. After some years I understood the reason for this distribution of opinions. I myself liked one half of the book and disliked the other one. I found very interesting the fact that my favorite parts were those in which I did not feel as an expert (one cannot be an expert in everything) and vice versa, I disliked those parts in which I had

made contributions myself. So I decided to make an attempt to rectify this inconsistency. The first logical step was to delete most of the contributions of my own. This was easy. The second part, namely writing on what other people have recently done, was really a heavy task for one obvious reason. I had to “decide what will remain in science and what will be forgotten”. To solve the problem, I simply decided to write what I liked most. As a result I deleted the section of the effect of non-convexity of the interatomic potentials on the structure of epitaxial interfaces, and added two new sections on the effect of Ehrlich–Schwoebel barrier and surfactants on the surface morphology. Although the two factors affect both the crystal and epitaxial growth I decided to put the first section in Chap. 3, and the second in Chap. 4. Significant changes have also been made in the sections dealing with the atomistic rate of nucleation and the saturation nucleus density. Moreover, I have looked for a long time for a more elegant way to introduce the criterion of stability of planar adsorbates against clustering. I was so fascinated by the approach of Sir Rudolf Peierls that I decided to reproduce the whole derivation from his brilliant three-page paper. This in turn led to a complete reshaping of the chapter dealing with the thermodynamic criterion of the mechanism of epitaxial growth.

Concerning the readability, a friend of mine told me that a textbook in physics is not a thriller, and the reader should make some effort to grasp the essence. Although I know some textbooks on solid state physics and statistical thermodynamics that read like thrillers to me, I decided to agree with him. Nevertheless, I tried to correct the text where, in my opinion, the latter was clumsy, or the problem ill-defined. So, I do hope that I have succeeded, at least partially, in updating the text in the right direction and making it more readable.

I would like to express my gratitude to G. H. Gilmer, T. T. Tsong, Th. Michely, M. Horn-von Hoegen and B. Voigtländer who gave me their kind permission to reproduce figures from their papers and supplied me with the corresponding files. Particularly, I am greatly indebted to B. Voigtländer for his kindness to grant me his permission to use the beautiful STM micrograph of “hut” clusters of Ge on

Si(001) for the cover of this book. I would like also to thank J. E. Prieto for the critical reading of Chap. 4.

*Ivan V. Markov*  
*Sofia, Bulgaria*