Preface

The physical properties of colloidal suspensions are strongly affected by the forces that act between the colloidal particles. Attempts to explain them in these terms go back to the beginning of the 20th century. Important and extensively studied forces in colloidal systems are Van der Waals forces, electrostatic forces, steric forces due to attached polymers and magnetic forces. In the last decades it has been observed that the stability of colloidal particles is also affected by non-adsorbing polymers in solution. The origin of this interaction was first explained successfully in 1954 by S. Asakura and F. Oosawa using the concept that the free volume available to non-adsorbing polymers increases whenever two hard particles approach sufficiently close such that their depletion zones overlap and the total depletion zone decreases.

However, a number of important applications were used in technology and medicine (long) before the depletion concept was introduced. For example, clustering of red blood cells due to serum proteins was already detected at the end of the 18th century and forms the basis of the blood sedimentation test still in use. Furthermore, creaming of colloidal particles to concentrate latex dispersions upon the addition of polysaccharides was first studied in the 1920s. Polysaccharides were also used in the isolation of plant viruses, starting in the 1940s. Systematic and fundamental investigations on the effect of depletion interactions in colloidal systems started with the work of B. Vincent in the UK, S. Hachisu in Japan, and A. Vrij in The Netherlands in the 1970s. Work on depletion interaction gained momentum after W.R. Russel and co-workers in the US clarified the relationship between the range and depth of the depletion interaction and the topology of the phase diagram in the 1980s. Since then the depletion field evolved rapidly.

This book aims at providing a self-contained treatment of the depletion interaction and the resulting phase behaviour in colloidal dispersions. It is hoped that the book may be equally useful to senior undergraduate students or beginning graduate students in physical chemistry, chemical and mechanical engineering, biophysicists or soft condensed matter physics. At the same time we hope that professional chemists and engineers dealing with colloidal suspensions may find it
a useful reference book to gain an understanding about the implications of the depletion interaction for the handling of suspensions.

In order to keep the size of the book within bounds a description of the interface between demixed phases has not been included and the discussion of phase transition kinetics is rather brief. Also we emphasize that the references quoted do not claim to be a complete list. If the reader prefers it, (s)he can read the book at three levels. For a general idea of depletion interactions and their implications not only in colloid science but also in systems of biological and technological interest it is recommended to study Chap. 1. At the second level one can study 2.1, 2.2, Chap. 3, 4.1, 4.2, 4.5 and 6.1–6.3, 6.5. This material could be used for 6–8 hour senior undergraduate or junior graduate course in physical chemistry or soft matter physics. The third level covers the complete text of this monograph.

Many people have stimulated us to write this book. Initially, we had hoped to write it with Dirk Aarts. His enthusiasm for the book project helped us greatly during the early stages but he was unable to reserve enough time for the book after his start in Oxford. We are indebted to him, to Jeroen van Duijneveldt and Gerard Fleer for commenting in detail on drafts of several chapters of the manuscript. It might well be that remaining errors and unclarities can be traced back to where we foolishly disagreed with them.

We were fortunate to have the meticulous help in the preparation of texts and figures of the manuscript by Mieke Kröner, while the illustrations benefited from the advice of Jeannette Kröner.

R.T. wishes to thank Jan Dhont and his Soft Matter group at the IFF of research center Jülich for their support during the initial stages leading to this book. The members of the Colloids & Interfaces group at DSM Research, Leon Bremer, Harm Langermans, Leo Vleugels, Benjamin Voogt, Jef Bisscheroux, and Feng Li, are acknowledged for the pleasant and stimulating interactions. Peter Jansens and Jeroen Kluytmans of DSM Research are thanked for supporting R.T. to finish the book. Collaborations with Martien Cohen Stuart, Tai-Hsi Fan, Kees de Kruijff, Peter Schurtenberger, Takashi Taniguchi, and Agienus Vrij contributed to the evolution of this book.

H.N.W.L. wishes to thank the staff members and his PhD students and Postdocs at the Van ’t Hoff laboratory with whom he had the privilege to work. He benefited from a long-term collaboration with Marc Baus, Louise Bailey, Mike Cates, Bob Evans, Seth Fraden, Daan Frenkel, Jean-Pierre Hansen, Joseph Indekeu, Geoff Maitland, Theo Odijk, Roberto Piazza, Wilson Poon, Peter Pusey, Bill Russel, Patrick Warren and Ben Widom. H.N.W.L. would like to thank the Royal Netherlands Academy of Arts and Sciences for the appointment as Academy Professor for the period 2006–2011, which made it possible to write this book.

Finally, we express our appreciation for the encouragement and pleasant cooperation with Maria Bellantone, Mieke van der Fluit and Liesbeth Mol of Springer Science + Business Media.

Geleen / Utrecht, April 2011

Remco Tuinier

Henk N. W. Lekkerkerker
Colloids and the Depletion Interaction
Lekkerkerker, H.N.W.; Tuinier, R.
2011, XIV, 234 p. 158 illus., 10 illus. in color., Softcover