

Coverings of Discrete Quasiperiodic Sets

Theory and Applications to Quasicrystals

Bearbeitet von
Peter Kramer, Zorka Papadopolos

1. Auflage 2002. Buch. xv, 273 S. Hardcover
ISBN 978 3 540 43241 8
Format (B x L): 15,5 x 23,5 cm
Gewicht: 662 g

Weitere Fachgebiete > Physik, Astronomie > Thermodynamik > Festkörperphysik,
Kondensierte Materie

Zu Inhaltsverzeichnis

schnell und portofrei erhältlich bei

The logo for beck-shop.de features the text 'beck-shop.de' in a bold, red, sans-serif font. Above the 'i' in 'shop' are three red dots of increasing size. Below the main text, 'DIE FACHBUCHHANDLUNG' is written in a smaller, red, all-caps, sans-serif font.

beck-shop.de
DIE FACHBUCHHANDLUNG

Die Online-Fachbuchhandlung beck-shop.de ist spezialisiert auf Fachbücher, insbesondere Recht, Steuern und Wirtschaft. Im Sortiment finden Sie alle Medien (Bücher, Zeitschriften, CDs, eBooks, etc.) aller Verlage. Ergänzt wird das Programm durch Services wie Neuerscheinungsdienst oder Zusammenstellungen von Büchern zu Sonderpreisen. Der Shop führt mehr als 8 Millionen Produkte.

Preface

In September 2000, the University of Bayreuth, Germany, hosted the Fourth International Meeting on Thermodiffusion (IMT4).

The IMT conferences were born from the idea of bringing together researchers in the field of thermodiffusion. Under the auspices of the *European Group of Research in Thermodiffusion* (EGRT) the conference series started in 1994 with IMT1 in Toulouse and has been continued every other year with IMT2 (Pau, 1996), IMT3 (Mons, 1998), and IMT4 (Bayreuth, 2000). The next conference, IMT5, will be held in 2002 in Lyngby, Denmark.

Thermodiffusion, also called thermal diffusion or the Ludwig-Soret effect, describes the coupling between a temperature gradient and a resulting mass flux. Although the effect was already discovered in the 19th century by Ludwig and Soret, it has gained growing interest during the last years due to improved experimental techniques like state-of-the-art thermogravitational columns, modern optical methods, flow channels, and microgravity experiments, to mention only a few. We are still far from a detailed microscopic picture, but analytical theories have been improved and the availability of fast computers and efficient algorithms for nonequilibrium molecular dynamics simulations has provided valuable input from the theoretical side.

The IMT conferences cover all aspects of thermodiffusion from fundamentals to new applications. Traditionally, the focus has been on the fluid state, ranging from mixtures of simple liquids to more complex systems such as critical mixtures, electrolytes, polymers, colloidal dispersions, or magnetic fluids. IMT4 tried to widen the scope by including a plenary lecture about thermodiffusion in ionic solids. Scientific input comes from diverse disciplines such as physics, chemistry, engineering, and geophysics.

Sadly, Leo Kempers passed away while this book was being prepared. Many of us have lost a friend and respected colleague. His manuscript has been brought into its final state by A. Shapiro, whom we want to thank here.

IMT4 would not have been possible without help from many people, ranging from the scientific committee to students, secretaries, and technicians helping with the local organization. We are grateful to the University of Bayreuth for hosting the conference and for financial support from the Deutsche Forschungsgemeinschaft, the Bavarian State Ministry of Education, Culture, Science and Art, the Emil Warburg Foundation, Wyatt Technology Germany, and the Max Planck Institute for Polymer Research.

Bayreuth, Mainz,
August 2001

Werner Köhler
Simone Wiegand

Organization of the Book

Since reviews about thermodiffusion research are scarce, it was our intention to provide a comprehensive overview of the current activities in the field in book form. Consequently, the contributions within this volume are not merely the papers presented at IMT4 but were written with the aim to contain both a review-like introduction together with recent research results. Hence, the book should be of value for both the experts and interested scientists working in different areas. It is organized in three Parts, but the classification is not always sharp.

In the First Part, general concepts, theoretical aspects and computer simulations are discussed. **Bjørn Hafskjold** reviews simulation methods to study thermal diffusion. Equilibrium molecular dynamic simulations using Green-Kubo formalism as well as non-equilibrium methods using linear response theory to derive the transport coefficients are discussed. **Jutta Luettmer-Strathmann** provides a summary on the asymptotic and crossover behavior of thermodiffusion and other transport properties close to the critical point. **Konstantin I. Morozov** develops a theory of the Soret effect on surfacted and ionic colloids. He shows that the double layer thickness and the electric potential of the particle surface determine the sign of the Soret coefficient. **Alexander A. Shapiro** and **Erling H. Stenby** discuss to what extent the concept of principle of entropy maximization can be transferred from the framework of equilibrium thermodynamics to non-equilibrium steady states. **Leo J.T.M. Kempers** uses a thermodynamic approach, which includes kinetic contributions to predict the Soret effect in multicomponent mixtures. Comparison with mixtures relevant to the chemical and petroleum industry shows agreement within a factor of two over four decades. **Ryszard Wojnar** derives a kinetic theory for Brownian particles under the influence of a gravity and a temperature field. He applies this theory to the thermodiffusion process in porous media. **Jan V. Sengers** and **José M. Ortiz de Zárate** demonstrate that the Soret effect induces long-range concentration fluctuations in a binary liquid system which is in a stationary thermal non-equilibrium state. **Jürgen Janek**, **Carsten Korte** and **Alan B. Lidiard** summarize the current state of thermodiffusion in ionic solids. Model experiments as well as theoretical approaches are discussed. The last contribution of the first Part is a song which was performed by **Florian Müller-Plathe** during his presentation. It gives a historic overview and presents recent results from computer simulations.

In the Second Part of the book, experimental techniques as well as their application to special systems, such as polymers, are discussed. In the first paper, **Simone Wiegand** and **Werner Köhler** summarize the recent applications and developments in optical grating techniques. The influence of convection and the approach of a critical point are discussed in more detail. **Guy Chavepeyer**, **Jean-François Dutrieux**, **Stéfan Van Vaerenbergh**, and **Jean-Claude Legros** describe experimental effects in thermal diffusion flow cells, which perturb the measurement of small Soret coefficients. They discuss numerical simulation results and compare those to experimental data. **Javier Valencia**, **Mohamed Mounir Bou-Ali**, **Oscar Ecenarro**, **José Antonio Madariaga** and **Carlos M. Santamaría** explain the limitations of the Furry, Jones and Onsager thermogravitational column theory. **Michel Martin**, **Charles Van Batten** and **Mauricio Hoyos** give a background in the thermal field flow fractionation technique, which is a standard liquid chromatography technique for polymer fractionation and characterization. **Martin E. Schimpf** reviews thermodiffusion theories. He compares them with experimental results obtained for various polymers by field flow fractionation and presents a recently developed hydrodynamic model.

The Third Part of the book covers theoretical and experimental aspects of thermodiffusion and convection, including thermodiffusion in porous media. In the first contribution, **Jean-Karl Platten**, **Jean-François Dutrieux** and **Guy Chavepeyer** discuss the combination of free convection and thermodiffusion for the measurement of Soret coefficients in Rayleigh-Bénard cells and thermogravitational columns. **Björn Huke** and **Manfred Lücke** summarize their finding about laterally periodic convection structures in binary mixtures in the Rayleigh-Bénard system for positive Soret effect. **Mark I. Shliomis** focuses on the convective instabilities in ferrofluid layers in a Rayleigh-Bénard cell heated from above or from below in the presence of a magnetic field. **Boris L. Smorodin**, **Bela I. Myznikova** and **Igor O. Keller** present a theoretical study of the influence of transverse vibrations on the formation of instabilities in binary mixtures. They show that, depending on the amplitude and frequency of the modulation, the vibrations can stabilize or destabilize the equilibrium state of the liquid. The last three papers in the third section discuss thermodiffusion in porous media. **Pierre Costesèque**, **Daniel Fargue** and **Philippe Jamet** review the experimental, theoretical and numerical studies performed on thermodiffusion and thermodiffusion-convection transport in porous media. **Mohamed N. Ouarzazi**, **Annabelle Joulin**, **Pierre-Antoine Bois** and **Jean K. Platten** study the pattern formation of a binary mixture in a porous medium heated from below in the presence of a horizontal flow. The book concludes with a paper by **Bruno Lacabanne**, **Serge Blancher**, **René Creff** and **François Montel**, who derive a model and perform numerical simulations for the Soret effect in multicomponent flow through porous media.

An attempt has been made to use a uniform nomenclature, but this has proved to be an almost impossible task with contributions from different scientific disciplines. The most important symbols that most authors could agree on are

summarized in a global glossary on page XVII. At the end of every contribution there is a supplementary glossary with the symbols not contained in the global one. Some authors preferred to stay with their own established notation and deviated from the conventions in the global glossary. Hence, the reader is always advised to check the supplementary glossary.

There is no agreement in the literature on how to define the sign of the Soret coefficient. The sign convention used in this book does not depend on the densities of the components and is explained in detail on page XVII.

We would like to express our thanks to the contributors to this volume for their enthusiasm and their ready cooperation in making this book a timely reflection of the progress achieved in various theoretical aspects and applications of thermodiffusion.

List of Contributors

Serge Blancher

Laboratoire de Transferts Thermiques
Université de Pau
64000 Pau, France
serge.blancher@univ-pau.fr

Pierre-Antoine Bois

Université de Lille
LML, 59655 Villeneuve d'Ascq Cedex,
France
pierre-antoine.bois@univ-
lille1.fr

Mohamed Mounir Bou-Ali

Departamento de Ingeniería Mecánica
Energética y de Materiales
Universidad Pública de Navarra
Pamplona, Spain
mounir.bouali@unavarra.es

Guy Chavepeyer

Université de Mons-Hainaut
General Chemistry
Avenue du Champ de Mars, 24,
B-7000 Mons, Belgium
guy.chavepeyer@umh.ac.be

Pierre Costesèque

Université Paul Sabatier
39, allées Jules Guesde
31000 Toulouse, France
costeseq@cict.fr

René Creff

Laboratoire de Transferts Thermiques
Université de Pau

64000 Pau, France

rene.creff@univ-pau.fr

Jean-François Dutrieux

Université de Mons-Hainaut
General Chemistry
Avenue du Champ de Mars, 24,
B-7000 Mons, Belgium
jean-francois.dutrieux@umh.ac.be

Oscar Ecenarro

Departamento de Física Aplicada II
Universidad del País Vasco, Apdo 644
48080 Bilbao, Spain
wdpecaro@lg.ehu.es

Daniel Fargue

Ecole des Mines de Paris
60, bd Saint Michel
75272 Paris Cedex 06, France
fargue@de.ensmp.fr

Bjørn Hafskjold

Department of Chemistry
Norwegian University of Science and
Technology
N-7491 Trondheim, Norway
bhaf@chembio.ntnu.no

Mauricio Hoyos

Ecole Supérieure de Physique
et de Chimie Industrielles
Laboratoire de Physique et Mécanique
des Milieux Hétérogènes
(UMR CNRS 7636), 10, rue Vauquelin
75231 Paris Cedex 05, France
hoyos@pmmh.espci.fr

Björn Huke

Institut für Theoretische Physik
Universität des Saarlandes
Postfach 151150
66041 Saarbrücken, Germany
huke@lusi.uni-sb.de

Philippe Jamet

Ecole des Mines de Paris
35, rue Saint-Honoré
77305 Fontainebleau Cedex, France
jamet@isige.ensmp.fr

Jürgen Janek

Physikalisch-Chemisches Institut
Justus-Liebig-Universität Gießen
Heinrich-Buff-Ring 58, 35392 Gießen,
Germany
juergen.janek@phys.chemie.
uni-giessen.de

Annabelle Joulin

Université de Lille
LML, 59655 Villeneuve d'Ascq Cedex
France
annabelle.joulin@univ-lille1.fr

Igor O. Keller

Intel Israel (74) Ltd.
P.O. Box 1659
Haifa, 31015 Israel
igor.keller@intel.com

Leo J.T.M. Kempers

Shell International Exploration
& Production
P.O. Box 60, 2280 AB Rijswijk
The Netherlands

Werner Köhler

Physikalisches Institut
Universität Bayreuth
95440 Bayreuth, Germany
werner.koehler@uni-bayreuth.de

Carsten Korte

Physikalisch-Chemisches Institut
Justus-Liebig-Universität Gießen
Heinrich-Buff-Ring 58, 35392 Gießen,
Germany
Carsten.Korte@phys.Chemie.
uni-giessen.de

Bruno Lacabanne

Laboratoire de Mathématiques
Appliquées
Université de Pau
64000 Pau, France
bruno.lacabanne@univ-pau.fr

Jean-Claude Legros

Université Libre de Bruxelles
Microgravity Research Center (MRC)
Chemical Physics E.P. Dept. - CP 165
Avenue F.D. Roosevelt, 50
B-1050 Bruxelles, Belgium
jclegros@ulb.ac.be

Alan B. Lidiard

The J.J. Thomson Physical
Laboratory
University of Reading
Whiteknights, Reading RG6 6AF, UK
A.B.Lidiard@reading.ac.uk

Manfred Lücke

Institut für Theoretische Physik
Universität des Saarlandes
Postfach 151150
66041 Saarbrücken, Germany
luecke@lusi.uni-sb.de

Jutta Luettmer-Strathmann

Department of Physics
The University of Akron
Akron, OH 44325-4001, USA
jutta@physics.uakron.edu

José Antonio Madariaga

Departamento de Física Aplicada II
Universidad del País Vasco, Apdo 644

48080 Bilbao, Spain
wupmazaj@lg.ehu.es

Michel Martin

Ecole Supérieure de Physique et de
Chimie Industrielles
Laboratoire de Physique et Mécanique
des Milieux Hétérogènes
(UMR CNRS 7636), 10, rue Vauquelin
75231 Paris Cedex 05, France
martin@pmmh.espci.fr

François Montel

Elf Exploration Production
Centre Scientifique Jean Feger
Pau, France
francois.montel@elf-p.fr

Konstantin I. Morozov

Institute of Continuous Media
Mechanics
UB of Russian Academy of Science
Korolev Str. 1
614013 Perm, Russia
mrk@icmm.ru

Florian Müller-Plathe

Max-Planck-Institut
für Polymerforschung
Ackermannweg 10
55128 Mainz, Germany
mplathe@mpip-mainz.mpg.de

Bela I. Myznikova

Institute of Continuous Media
Mechanics
UB of Russian Academy of Science
Korolev Str. 1
614013 Perm, Russia
myz@icmm.ru

José M. Ortiz de Zárate

Departamento de Física Aplicada 1
Facultad de Ciencias Físicas
Universidad Complutense
E-28040 Madrid, Spain
fiap102@sis.ucm.es

Mohamed Najib Ouarzazi

Université de Lille
LML, 59655 Villeneuve d'Ascq Cedex
France
ouarzazi.najib@univ-lille1.fr

Jean Karl Platten

Université de Mons-Hainaut
General Chemistry
Avenue du Champ de Mars, 24,
B-7000 Mons, Belgium
jean.platten@umh.ac.be

Carlos María Santamaría

Departamento de Física Aplicada II
Universidad del País Vasco Apdo 644
48080 Bilbao, Spain
wdpsasac@lg.ehu.es

Martin E. Schimpf

Department of Chemistry
Boise State University
Boise, ID 83725, USA
mschimpf@boisestate.edu

Jan V. Sengers

Institute for Physical Science
and Technology
and Department of Chemical
Engineering
University of Maryland
College Park, MD 20742, USA
sengers@ipst.umd.edu

Alexander A. Shapiro

Engineering Research Center
IVC-SEP
Department of Chemical Engineering
Technical University of Denmark
DK 2800 Lyngby, Denmark
ash@kt.dtu.dk

Mark I. Shliomis

Department of Mechanical
Engineering
Ben-Gurion University of the Negev
P.O.B. 653, Beer-Sheva 84105, Israel
shliomis@netvision.net.il

Boris L. Smorodin

Perm State University
Department of Theoretical Physics
Bukirev str. 15
614600 Perm, Russia
boris.smorodin@psu.ru

Erling H. Stenby

Engineering Research Center
IVC-SEP
Department of Chemical Engineering
Technical University of Denmark
DK 2800 Lyngby, Denmark
ehs@kt.dtu.dk

Javier Valencia

Departamento de Ingeniería Mecánica
Energética y de Materiales
Universidad Pública de Navarra
Pamplona, Spain
valencia@unavarra.es

Charles Van Batten

Ecole Supérieure de Physique
et de Chimie Industrielles
Laboratoire de Physique et Mécanique
des Milieux Hétérogènes
(UMR CNRS 7636), 10, rue Vauquelin
75231 Paris Cedex 05, France
charles.van.batten@yahoo.com

Stéfan Van Vaerenbergh

Université Libre de Bruxelles
Microgravity Research Center (MRC)
Chemical Physics E.P. Dept., CP 165
Avenue F.D. Roosevelt, 50
B-1050 Bruxelles, Belgium
svanvaer@ulb.ac.be

Simone Wiegand

Max-Planck-Institut
für Polymerforschung
Ackermannweg 10
55128 Mainz, Germany
wiegand@mpip-mainz.mpg.de

Ryszard Wojnar

Instytut Podstawowych Problemów
Techniki
Polska Akademia Nauk
ul. Świętokrzyska 21
00-049 Warszawa, Poland
rwojnar@ippt.gov.pl

Glossary of Symbols

c	concentration (weight fraction)
c_p	specific heat capacity at constant pressure
c_v	specific heat capacity at constant volume
D	mutual diffusion coefficient
D_T	thermal diffusion coefficient
D_{th}	thermal diffusivity
F	Helmholtz free energy
k_B	Boltzmann's constant
Le	Lewis number
M	molar mass
Pr	Prandtl number
q	wave vector
t	time
Ra	Rayleigh number
Re	Reynolds number
Sc	Schmidt number
S_T	Soret coefficient (see below for sign convention): $S_T = D_T/D$
T	temperature
x	concentration (mole fraction)
u	fluid velocity
α	cubic expansion coefficient: $\alpha = -\left(\frac{1}{\rho} \frac{\partial \rho}{\partial T}\right)_{p,c}$
α_T	thermal diffusion factor: $\alpha_T = TS_T$
β	solutal expansion coefficient: $\beta = \left(\frac{1}{\rho} \frac{\partial \rho}{\partial c}\right)_{p,T}$
λ	wavelength of light
λ_T	thermal conductivity
μ	difference in chemical potential per unit mass between the two species in a binary mixture
ϕ	concentration (volume fraction)
ψ	separation ratio: $\psi = \frac{\beta}{\alpha} S_T c(1 - c)$
ρ	mass density

Sign convention for S_T and D_T

In a binary mixture of A and B, ' S_T of A' (and also D_T) is positive if A migrates to the cold side. This implies that S_T of B must be negative, since B migrates to the hot side. Usually, one would specify S_T for the component that has been used for the definition of the concentration. Note that this definition does not depend on the densities of the two components.