

Siegbert Schmid · Ray L. Withers
Ron Lifshitz *Editors*

Aperiodic Crystals

 Springer

Siegbert Schmid • Ray L. Withers • Ron Lifshitz
Editors

Aperiodic Crystals

 Springer

Editors

Siegbert Schmid
School of Chemistry
The University of Sydney
Sydney, New South Wales, Australia

Ron Lifshitz
School of Physics & Astronomy
Tel Aviv University
Tel Aviv, Israel

Ray L. Withers
Research School of Chemistry
The Australian National University
Canberra, Australia

ISBN 978-94-007-6430-9

ISBN 978-94-007-6431-6 (eBook)

DOI 10.1007/978-94-007-6431-6

Springer Dordrecht Heidelberg New York London

Library of Congress Control Number: 2013936945

© Springer Science+Business Media Dordrecht 2013

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed. Exempted from this legal reservation are brief excerpts in connection with reviews or scholarly analysis or material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work. Duplication of this publication or parts thereof is permitted only under the provisions of the Copyright Law of the Publisher's location, in its current version, and permission for use must always be obtained from Springer. Permissions for use may be obtained through RightsLink at the Copyright Clearance Center. Violations are liable to prosecution under the respective Copyright Law.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

While the advice and information in this book are believed to be true and accurate at the date of publication, neither the authors nor the editors nor the publisher can accept any legal responsibility for any errors or omissions that may be made. The publisher makes no warranty, express or implied, with respect to the material contained herein.

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

ВЕДЕЛАПНОЕ ГОСУДАРСТВЕННОЕ

Contents

1	A Brief History of Aperiodic Crystals: 1962–2012	1
	T. Janssen	
2	Squiral Diffraction	11
	U. Grimm and M. Baake	
3	Random Noble Means Substitutions	19
	M. Baake and M. Moll	
4	Magic Numbers in the Discrete Tomography of Cyclotomic Model Sets	29
	C. Huck	
5	Some Comments on the Inverse Problem of Pure Point Diffraction	35
	V. Terauds and M. Baake	
6	Well-Rounded Sublattices and Coincidence Site Lattices	43
	P. Zeiner	
7	Octagon-Based Quasicrystalline Formations in Islamic Architecture	49
	R. Al Ajlouni	
8	The Ammann–Beenker Tilings Revisited	59
	N. Bédaride and T. Fernique	
9	Substitution Rules and Topological Properties of the Robinson Tilings	67
	F. Gähler	
10	Short-Range Spin Fluctuation in the Zn–Mg–Tb Quasicrystal and Its Relation to the Boson Peak	75
	I. Kanazawa, M. Saito, and T. Sasaki	

11	Anomalous Properties and the Electronic Glass-Like State in Al-Based Stable Quasicrystals	81
	K. Yamada, T. Sasaki, and I. Kanazawa	
12	Quantum Diffusion in Separable d-Dimensional Quasiperiodic Tilings	89
	S. Thiem and M. Schreiber	
13	Hume–Rothery Stabilization Mechanism of Be-Based Complex Alloys	95
	H. Sato, M. Inukai, E.S. Zijlstra, and U. Mizutani	
14	Hume–Rothery Stabilization Mechanism in Tsai-Type Cd_6Ca Approximant and e/a Determination of Ca and Cd Elements in the Periodic Table	101
	U. Mizutani, M. Inukai, H. Sato, K. Nozawa, and E.S. Zijlstra	
15	Hume–Rothery Stabilization Mechanism in Low-Temperature Phase Zn_6Sc Approximant and e/a Determination of Sc and Y in M–Sc and M–Y (M = Zn, Cd and Al) Alloy Systems	109
	U. Mizutani, M. Inukai, H. Sato, and E.S. Zijlstra	
16	Analysis of Dislocations in Quasicrystals Composed of Self-assembled Nanoparticles	117
	L. Korkidi, K. Barkan, and R. Lifshitz	
17	Average Unit Cell in Fourier Space and Its Application to Decagonal Quasicrystals	125
	B. Kozakowski and J. Wolny	
18	A Study of Phase Equilibria in the Al–Pd–Co System at 700 °C	133
	I. Černíčková, R. Čička, P. Švec, D. Janičkovič, P. Priputen, and J. Janovec	
19	Evolution of Phases in Selected Al–Co–Cu Complex Metallic Alloys Under Near-Equilibrium Conditions at 800–1150 °C	141
	P. Priputen, T.Y. Liu, I. Černíčková, D. Janičkovič, P. Švec, E. Illeková, M. Drienovský, R. Čička, and J. Janovec	
20	Superspace Description of the System $\text{Bi}_{2(n+2)}\text{Mo}_n\text{O}_{6(n+1)}$ ($n = 3, 4, 5$ and 6)	149
	P.J. Bereciartua, F.J. Zuñiga, J.M. Perez-Mato, V. Petříček, E. Vila, A. Castro, J. Rodríguez-Carvajal, and S. Doyle	
21	Pseudo-Commensurate $\text{GdBaCo}_2\text{O}_{5+\delta}$ and Its Phase Transition at Elevated Temperatures	157
	N. Ishizawa, T. Asaka, T. Kudo, K. Fukuda, N. Abe, and T. Arima	
22	$\text{Al}_4(\text{Cr,Fe})$: A Structure Survey	163
	B. Bauer, B. Pedersen, and F. Frey	

23	Phase Transitions in Aperiodic Composite Crystals	171
	P. Rabiller, B. Toudic, C. Mariette, L. Gu�erin, C. Ecolivet, and M.D. Hollingsworth	
24	Pseudo-Symmetry in Tungsten Bronze Type $\text{Sr}_3\text{TiNb}_4\text{O}_{15}$	179
	T.A. Whittle, W.R. Brant, and S. Schmid	
25	Structural Investigation of the Incommensurate Modulated $\text{Ta}_2\text{O}_5\text{-Al}_2\text{O}_3$ System	187
	D.T. Murphy, V. Fung, and S. Schmid	
26	First-Principles Study for Phase Diagrams of Cd–Ca and Cd–Y Tsai-Type Approximants Under Pressure	195
	K. Nozawa and Y. Ishii	
27	The Choice of Vector Basis for Ammann Tiling in a Context of the Average Unit Cell	203
	R. Strzalka, J. Wolny, and P. Kuczera	
28	Real Space Structure Factor and Scaling for Quasicrystals	211
	J. Wolny, B. Kozakowski, P. Kuczera, L. Pytlik, and R. Strzalka	
29	Direct Observations of Aperiodic Arrangements of Transition- Metal Atoms in Al–Co–Ni Decagonal Quasicrystals by Cs-Corrected HAADF-STEM	219
	A. Yasuhara, K. Saito, and K. Hiraga	
30	Arrangement of Transition-Metal Atoms in an Approximant Crystal Related to Al–Cu–Co Decagonal Quasicrystals Studied by Cs-Corrected HAADF-STEM	225
	K. Yubuta, A. Yasuhara, and K. Hiraga	
31	Structure of ϵ_{16} Phase in Al–Pd–Co System Studied by HREM and X-Ray Diffraction	231
	K. Yubuta, S. Suzuki, R. Simura, and K. Sugiyama	
32	Structure of $\tau^2\text{-Al}_3\text{Co}$, a Monoclinic Approximant of the Al–Co Decagonal Quasicrystal	237
	K. Sugiyama, A. Yasuhara, and K. Hiraga	
33	Reverse Monte Carlo Study of Diffuse Scattering from a Frustrated Protein System	243
	T.R. Welberry, A.P. Heerdegen, and P.D. Carr	
34	Dynamical Flexibility in the Periodic Zn_6Sc 1/1-Approximant	253
	H. Euchner, T. Yamada, H. Schober, S. Rols, M. Mihalkovi�, R. Tamura, T. Ishimasa, and M. de Boissieu	
35	Trajectories of Colloidal Particles in Laser Fields with Eight-, Ten-, or Twelve-Fold Symmetry and Phasonic Drift	261
	M. Sandbrink and M. Schmiedeberg	

36 Catalytic Properties of Five-Fold Surfaces of Quasicrystal Approximants	269
M. Krajčí and J. Hafner	
37 Effect of Leaching on Surface Microstructure and Chemical Composition of Al-Based Quasicrystals	275
T.P. Yadav, M. Lowe, R. Tamura, R. McGrath, and H.R. Sharma	
Index	283