### 图书基本信息

- 书名: <<准晶数学的弹性理论及应用>>
- 13位ISBN编号:9787030256690
- 10位ISBN编号:7030256697
- 出版时间:2010-1
- 出版时间:科学出版社
- 作者: Tianyou Fan 编
- 页数:363
- 版权说明:本站所提供下载的PDF图书仅提供预览和简介,请支持正版图书。

更多资源请访问:http://www.tushu007.com

# 第一图书网, tushu007.com <</

### 前言

This monograph is devoted to the development of a mathematical theory of elasticit: of quasicrystals and its applications. Some results on elastodynamics and plasticitl of quasicrystals are also included to document preliminary advances in recent years The first quasierystal was observed in 1982 and reported in November 1984. A that time several physical and mathematical theories for quasicrystal study alreadl existed. Soon after the discovery, the theory of elasticity of quasicrystals was pu forward. Based on Landau-Anderson symmetry-breaking, a new elementary exci ration - the phason - was introduced in addition to the well known phonon. The phason concept was suggested in the 1960's in incommensurate phase theory. Groul theory and discrete geometry e.g. the Penrose tiling provide further explanation to quasierystals and their elasticity from the standpoint of algebra and geometry The phonon and phason elementary excitations form the basis of the theory of elas ticity of this new solid phase. Many theoretical (condensed matter) physicists have spent a great deal of effort on constructing the fundamental physical framework othe theory of elasticity of quasicrystals. Applications of group theory and groul representation theory further enhance the physical basis of the description. On the, basis of the physical framework and by extending the methodology of mathematica physics and classical elasticity, the mathematical theory of elasticity of quasierystal, has been developed. Recent studies on the elasto-/hydro-dynamics and the plastic. ity of quasierystals have made preliminary but significant progress. As regards the dynamics, there are various viewpoints in the quasierystal community, which the unusual characteristics of phason dynamics. Yet the effect of the phason de. grees of freedom on plastic deformation is not well understood, and the basic plastic properties of the material are virtually unknown. Because of many unsolved critica issues, the study of quasicrystals has attracted many researchers. The contex of the last few chapters in this book is a probe of the fascinating research area.

#### 内容概要

This inter-disciplinary work covering the continuum mechanics of novel materials, condensed matter phyics and partial differential equations discusses the mathematical theory of elasticity of quasicrystals (a new condensed matter) and its applications by setting up new partial differential equations of higher order and their solutions under complicated boundary value and initial value conditions. The new theories developed here dramatically simplify the solving of complicated elasticity equation systems. Large numbers of complicated equations involving elasticity are reduced to a single or a few partial differential equations of higher order. Systematical and direct methods of mathematical physics and complex variable functions are developed to solve the equations under appropriate boundary value and initial value conditions, and many exact analytical solutions are constructed.

### 书籍目录

PrefaceChapter1 Crystals 1.1 Periodicity of crystal structure, crystal cell 1.2 Three-dimensional lattice types 1.3 Symmetry and point groups 1.4 Reciprocal lattice 1.5 Appendix of Chapter1: Some basic concepts References Chapter 2 Framework of the classical theory of elasticity 2.1 Review on some basic concepts 2.2
Basic assumptions of theory of elasticity 2.3 Displacement and deformation 2.4 Stress analysis and equations of motion 2.5 Generalized Hooke's law 2.6 Elastodynamics, wave motion 2.7 Summary References Chapter 3 Quasicrystal and its properties 3.1 Discovery of quasicrystal 3.2 Structure and symmetry of quasicrystals 3.3
A brief introduction on physical properties of quasicrystals 3.4 One-, two- and three-dimensional quasicrystals

3.5 Two-dimensional quasicrystals and planar quasicrystals References Chapter 4 The physical basis of elasticity of quasicrystals 4.1 Physical basis of elasticity of quasicrystals 4.2 Deformation tensors 4.3 Stress tensors and the equations of motion 4.4 Free energy and elastic constants 4.5 Generalized Hooke's law 4.6 Boundary conditions and initial conditions 4.7 A brief introduction on relevant material constants of quasicrystals 4.8 Summary and mathematical solvability of boundary value or initial- boundary value problem

4.9 Appendix of Chapter 4: Description on physical basis of elasticity of quasicrystals based on the Landau density wave theory ReferencesChapter 5 Elasticity theory of one-dimensional quasicrystals and simplification

5.1 Elasticity of hexagonal quasicrystals
5.2 Decomposition of the problem into plane and anti-plane problems
5.3 Elasticity of monoclinic quasicrystals
5.4 Elasticity of orthorhombic quasicrystals
5.5 Tetragonal quasicrystals
5.6 The space elasticity of hexagonal quasicrystals
5.7 Other results of elasticity of one-dimensional quasicrystals
8 References
9 Chapter 6 Elasticity of two-dimensional quasicrystals and
9 simplification
9.1 Basic equations of plane elasticity of two-dimensional quasicrystals: point groups 5m and10mm in five- and ten-fold symmetries
9.2 Simplification of the basic equation set: displacement potential function method
9.3 Simplification of the basic equations set: stress potential function method
9.4 Plane elasticity of point group 10, decagonal quasicrystals
9.5 Plane elasticity of point group 12mm of dodecagonal quasicrystals
9.6 Plane elasticity of point group 5, pentagonal and point group 6, pentagonal and point group 5, pentagonal and point group 6, pentagonal and point group 10, decagonal quasicrystals, displacement potential
9.7 Stress potential of point group 5, pentagonal and point group 10, decagonal quasicrystals
9.8 Stress potential of point group 8 mm octagonal quasicrystals
9.9 Engineering and mathematical elasticity of quasicrystals

References Chapter 7 Application I: Some dislocation and interface problems and solutions in one- and two, dimensional quasicrystals 7.1 Dislocations in one-dimensional hexagonal quasicrystals 7.2 Dislocations in quasicrystals with point groups 5m and 10mm symmetries 7.3 Dislocations in quasicrystals with point groups 5, five-fold and 10, ten-fold symmetries 7.4 Dislocations in quasicrystals with eight-fold symmetry 7.5 Dislocations in dodecagonal quasicrystals 7.6 Interface between quasicrystal and crystal 7.7 Conclusion and discussion References Chapter 8 Application II: Solutions of notch and crack problems of one- and two-dimensional quasicrystals 8.1 Crack problem and solution of one-dimensional quasicrystals 8.2 Crack problem in finite-sized one-dimensional quasicrystals 8.3 Griffith crack problems in point groups 5m and 10mm quasicrystals based on displacement potential function method 8.4 Stress potential function formulation and complex variable function method for solving notch and crack problems of quasicrystals of point groups 5, and 10,

8.5 Solutions of crack/notch problems of two-dimensional octagonal quasicrystals
8.6 Other solutions of crack problems in one-and two-dimensional quasicrystals
8.7 Appendix of Chapter 8: Derivation of solution of Section
8.1 References Chapter 9 Theory of elasticity of three-dimensional quasicrystals and its applications
9.1 Basic equations of elasticity of icosahedral quasicrystals
9.2 Anti-plane elasticity of icosahedral quasicrystals and problem of interface between quasicrystal and crystal
9.3 Phonon-phason decoupled plane elasticity of icosahedral quasicrystals displacement potential formulation
9.5 Phonon-phason coupled plane elasticity of icosahedral quasicrystals stress potential formulation
9.6 A straight dislocation in an icosahedral quasicrystals
9.7 An elliptic notch/Griffith crack in an icosahedral quasicrystals
9.8 Elasticity of cubic quasicrystals
9.7 An elliptic notch/Griffith crack in an icosahedral quasicrystals
9.8 Elasticity of cubic quasicrystals
9.7 An elliptic notch/Griffith crack in an icosahedral quasicrystals

quasicrystals followed the Bak's argument 10.2 Elastodynamics of anti-plane elasticity for some quasicrystals

10.3 Moving screw dislocation in anti-plane elasticity 10.4 Mode III moving Griftith crack in anti-plane elasticity 10.5 Elasto-/hydro-dynamics of quasicrystals and approximate analytic solution for moving screw dislocation in anti-plane elasticity 10.6 Elasto-/hydro-dynamics and solutions of two-dimensional decagonal quasicrystals 10.7 Elasto-/hydro-dynamics and applications to fracture dynamics of icosahedral quasicrystals

10.8 Appendix of Chapter10: The detail of finite difference scheme References Chapter 11 Complex variable function method for elasticity of quasicrystalsChapter 12 Variational principle of elasticity of quasicrystalsChapter 13 Some mathematical principles on solutions of elasticity of quasicrystalsChapter 14 Nonlinear behaviour of quasicrystalsChapter 15 Fracture theory of quasicrystalsChapter 16 Remarkable conclusionReferencesMajor Appendix: On some mathematical materialsAppendix I Outline of complex variable functions and some additional calculationsAppendix II Dual integral equations and some additional calculations.AReferencesIndex

### 章节摘录

插图: In general, the course of crystallography does not contain the contents given in this section. Because the discussion here is dependent on quasicrystals, especially with the elasticity of quasicrystals, we have to introduce some of the simplest relevant arguments. In 1900, Planck put forward the quantum theory. Soon after Einstein developed the theory and explained the photo-electric effect, which leads to the photon concept. Einstein also studied the specific heat c~ of crystals by using the Planck quantum theory. There are some unsatisfactory points in the work of Einstein although his formula explained the phenomenon of  $c \sim = 0$  at T = 0, where T denotes the absolute temperature. To improve Einstein's work, Debye[3] and Born et al. [4,5] applied the quantum theory to study the specific heat arising from lattice vibration in 1912 and 1913 respectively, and got a great success. The theoretical prediction is in excellent agreement to the experimental results, at least for the atom crystals. The propagation of the lattice vibration is called the lattice wave. Under the long-wavelength approximation, the lattice vibration can be seen as continuum elastic vibration, i.e., the lattice wave can be approximately seen as the continuum elastic wave. The motion is a mechanical motion, but Debye and Born assumed that the energy can be quantized based on Planck's hypothesis. With the elastic wave approximation and quantization, Debye and Born successfully explained the specific heat of crystals at low temperature, and the theoretical prediction is consistent with the experimental results in all range of temperature, at least for the atomic crystals. The quanta of the elastic vibration, or the smallest unit of energy of the elastic wave is named phonon, because the elastic wave is one of acoustic waves. Unlike photon, the phonon is not an elementary particle, but in the sense of quantization, the phonon presents natural similarity to that of photon and other elementary particles, thus can be named quasi-particle. The concept created by Debye and Born opened the study on lattice dynamics, an important branch of solid state physics. Yet according to the view point at present, the Debye and Born theory on solid belongs to a phenomenological theory, though they used the classical quantum theory.

#### 编辑推荐

《资源环境承载能力评价》可供受灾地区和支援灾区重建的各级政府部门,以及关心和参与灾区重建 的专业人士参考。

### 版权说明

本站所提供下载的PDF图书仅提供预览和简介,请支持正版图书。

更多资源请访问:http://www.tushu007.com