Chapter 1
Higher-Dimensional Space of Nanoworld

ABSTRACT

In this chapter, a geometrical model to accurately describe the distribution of light points in diffraction patterns of quasicrystals is proposed. It is shown that the proposed system of parallel lines has axes of the fifth order and periodically repeating the fundamental domain of the quasicrystals. This fundamental domain is 4D-polytope, called the golden hyper-rhombohedron. It consists of eight rhombohedrons densely filling the 4D space. Faces of the hyper-rhombohedron are connected by the golden section; they can be scaled as needed. On this universal lattice of the vertices of the golden hyper-rhombohedrons, famous crystallographic lattices—Bravais, Delone, Voronoi, etc.—can be embedded. On the lattice of the vertices of the golden hyper-rhombohedrons, projections of all regular three-dimensional convex bodies—Plato's bodies—can be constructed.

INTRODUCTION

The consideration of clusters in the space of higher dimension must begin with the presentation of general ideas about the highest dimension of the nanoworld, arising from the geometric analysis of intermetallic diffractograms.

Incommensurate (modulated) structures (Izyumov, 1984) are widespread in nature. They include liquid crystals (chiral smectics), quasi - crystals, intercalated graphite compounds (structure consisting of alternating layers

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of carbon and layers of metal atoms), hardening alloys, etc. They may also include various types of ore bodies, consisting usually of many layers and distributed inclusions of different shape from different substances. The content of the definition "incommensurate" means that in these structures some basic structure with the translational symmetry can be distinguished and a substructure, which either has no translational symmetry, or has translational symmetry, but its period is incommensurate with the period of translating the basic structure (Gridnev, 1977). In both cases, the overall structure consisting of basic structure and substructure has no translational symmetry. Such structures are the result of different influences on the initial body with translational symmetry – thermal, mechanical, electrical, magnetic ones. The absence of translational symmetry in the incommensurate phase combines them with quasi - crystals, which got its name precisely because of the lack of translational symmetry in their diffraction patterns.

The concept of earth reality space introduced by Vernadsky (1965) and his evaluation of Pierre Curie's (Curie, 1966) principle of dissymmetry as a tool for the study of this space are of considerable interest to both the construction of the theory of rocks, and for the understanding of biological morphogenesis processes (Belousov, 2013). According to Pierre Curie's principle of dissymmetry, for the results of earthly reality phenomena some deviations from mentally attainable symmetry limit are characteristic. Rocks are formed as a result of complex physical, chemical and mechanical processes, in this regard Landau's (Landau, 1937) theory of phase transitions, linking the decrease of order of the symmetry group of a substance occurring in it under the influence of temperature and mechanical external effects is of great interest (Zhizhin, 2014e). One important consequence of this theory of Landau discovered in recent decades is the experimental proof of the existence of incommensurate phases. The decrease of the order of symmetry group is also characteristic of living organisms in the course of their development (Belousov, 2013), these changes being also associated with phase transitions as a stage in their development. Thus, it can be claimed that the decrease of order of symmetry is a general property of natural bodies being in the space of earthly reality (Zhizhin, 2014b). The most studied (both experimentally and theoretically) are the issues of crystalline solids structure changing. Therefore, one turn to studies of incommensurate crystalline solids structures taking into account the modern concepts of generalized crystallography (Lord, Mackay, & Ranganathan, 2006; Shevchenko, Zhizhin, & Mackay, 2013a, b; Zhizhin, 2014d; Zhizhin, & Diudea, 2016; Zhizhin, 2018).

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