Chapter 2
Higher Dimensions of Clusters of Intermetallic Compounds

ABSTRACT

The author has previously proved that diffraction patterns of intermetallic compounds (quasicrystals) have translational symmetry in the space of higher dimension. In this chapter, it is proved that the metallic nanoclusters also have a higher dimension. The internal geometry of clusters was investigated. General expressions for calculating the dimension of clusters are obtained from which it follows that the dimension of metallic nanoclusters increases linearly with increasing number of cluster shells. The dimensions of many experimentally known metallic nanoclusters are determined. It is shown that these clusters, which are usually considered to be three-dimensional, have a higher dimension. The Euler-Poincaré equation was used, and the internal geometry of clusters was investigated.

INTRODUCTION

A systematic study of the geometry of the structures of chemical compounds (Zhizhin, 2014a, b, c, d, 2016, 2018, 2019a) showed that almost all elements of the periodic system form molecules of higher dimension. It is natural to assume that clusters, as larger than education molecules, including a large number of atoms, can have a higher dimension. However, until recently, clusters considered as three - dimensional objects (Lord, Mackay, & Ranganathan, 2006; Pauling, 1960). This Chapter discusses clusters of real chemical

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compounds (as opposed to the book of Diudea, 2018, in which, as the author emphasizes, clusters are not related to real chemical compounds). Moreover, in this work, consideration of clusters is limited to a special type of chemical compounds - intermetallic compounds, since the study of intermetallic compounds has had a significant impact on the development of scientific views in recent decades. In particularly, the discovery of so - called quasicrystals is associated with intermetallic compounds, i.e. crystals supposedly devoid of translational symmetry (Shechtman et al., 1984). Although it was later shown that quasicrystals have translational symmetry, but in the space of higher dimension (Shevchenko, Zhizhin, & Mackay, 2013a, b; Zhizhin, 2014c; Zhizhin, & Diudea, 2016). The ideas about the higher dimension of clusters and the calculation of this dimension should be taken account to in their practical use as objects with valuable physic - chemical properties.

CLASTERS OF MACKAY

Mackay's cluster consists of two icosahedrons of different sizes with a common center (Mackay, 1962). A larger icosahedron is obtained by attaching a number of tetrahedrons and octahedrons to the surface of the smaller icosahedron.

Figure 1. The cluster of Mackay