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Identification of the Probable Geometric Peculiarities of the Modular 3D Structures by Hyperspatual Formalism Method

***Key words**: modular structure, hyper-spatial formalism method, hyper-cell, topology of cell, symmetric sections, polytopes of 4D space.*

***Annotation** –The possibilities of hyper-spatial formalism method to identify likely features of cell geometry of the modular 3D structures were discussed. The ways to define the image 4D structure into 3D space and define of its basic topology were considered.*

It is well-know the crystal chemical phenomenon characterized by certain relationships between various structural types of substances (1). Some of these phenomena are corresponds to real physical-chemical processes. However, the facts of manifestations of any crystal chemical anomalies and geometric topology of the structures or their specific structural elements are cannot always to explain by any particular physical-chemical process, which linked this anomalous structure with its probable structural "relative". Examples included the incidents of abnormal hyper-co-ordinations of atoms (2), an abnormally high or low atomic density in the fragments 3D structures with dimensionality of fewer than three (3, 4) and in local areas of modular structures, into possible quasi-crystal fragments of 3D structures, anomalous aperiodic and quasi-crystal states of 3D structures (5 – 7).

The problem decision of determining the probable relationship of the geometric properties of certain 3D structures with similar geometric properties of 4D structures, as well as the possible quantitative and qualitative impact of the kind of structural additions hyper-space 3D structures on some physical-chemical properties of their representatives, may be based on the solution of the following two groups of the task by hyper-spatial formalism method (8 – 17).

Tasks of the first group: 1) definition of probable hyper-cells of the 4D structures, if its 3D cross-sections and sweep of 3D "surface" are corresponds to specified 3D structure, 2) identification of the probable structural "sequels" of the specified cell 3D structures in a further dimension of hyperspace.

Tasks of the second group: 1) definition of probable cell of the 3D structures, which corresponds to specified symmetric cross-section of hyper-cell of 4D structure and the specified symmetric scan of its 3D "surface", 2) other pertinent definition of symmetric sections of lesser dimension and identification of the cells of 3D structures, which continued in an additional spatial dimension leads to formation of hyper-cells of 4D structure.

The relevance of the decision of these problems was conditioned by the next: 1) definition of topological characteristics of nD and (n-1)D-structures with a view to identifying regularities of their changes from nD structure to ((n-1) D structure, 2) the establishment of a new genetic link between 3D structures that have the same "continue" in the hyperspace dimension, and between 4D structures entities that derive from the same 3D structure, 3) define the role of possible structural synergism in the manifestation of qualitatively identical properties of 3D structures with the same "sequels" in the hyperspace dimension, and of qualitatively different properties of 4D entities that derive from the same 3D structure, 4) the formation of synergic model describing changing certain properties of 3D structures while taking into account the measurement and interpretation of role of the hyperspace dimension into possible structural synergism, 5) development of the conditions predictive model of 3D structures formation of inorganic substances with a necessary of manifestations level of the physical and chemical properties.

Consider the following ways to define image 4D structure in 3D space and define of its basic topological characteristics (the number and configurations of structural elements with smaller dimensions and their local topology, symmetric presentation of the structure and its possible topological derivative (8-17)). There are: 1) image recovery of the hyper-cell 4D structure enough its projective space images in smaller spatial dimensions, or symmetric flattening its 3D "surface" into 3D space, 2) getting the integrated image of hyper-cell 4D structure to end its series of symmetric sections, or sections of its sweep.

To implement these methods shall follow the following assumptions.

Assumption 1. If there is an image (an image) of the hyper-cell of 4D structure into 2D space, then it matches at least one of its high symmetric projections to the 3D space and one high symmetric scan its 3D "surface" in 3D space.

In connection with this assumption onto high symmetric projective image and symmetric derived from sweep of the hyper-cell of 4D structure into 3D space can be obtained from one and only one 4D structure with the corresponding topological characteristics.

Assumption 2. For any hyper-cell of 4D structure is exist the (5-i) different kinds of symmetric (4-i)(D) sections and (4-i) different kinds of symmetric (3-i)(D) sections sweep its 3D "surface", where $i < 3$.

In this case, images (4-i)(D) sections sweep "surface" of the 4D structure can be uniquely identified the prototype – the symmetrical scan "surface" in 3D space, and by images (5-i) different kinds of symmetric cross-sections can be restored the corresponding prototype – the image of the 4D structure.

It is necessary to note, the descriptions of the possible structural states of crystalline and nano-dimensional objects their site and size-distributions on the surface and into volume of composite coatings with anti-friction properties (18-20) and the forecasting of these coatings with necessary properties (21) were made largely by hyper-spatial formalism method, too.

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