ON THE SYNTHESIS OF INTERCONNECTED REGULAR TURING STRUCTURES WITH THE TOPOLOGY OF TRIPLY PERIODIC SURFACES OF MINIMAL ENERGY

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When analyzing the physical properties of a material, especially to assess the prospects for its use in various conditions, the natural desire of technologists and designers is to obtain a regular (periodic) bulk interconnected microstructure that is homogeneous in composition and properties. The first step towards solving this problem is the use of topology in the structural chemistry of matter and materials, including composites, for the realization of triply periodic surfaces of minimal energy (TPMS). This problem was briefly formulated by von Schnering in 1987 - “how nature implements periodic minimal surfaces in chemical structures”. It turned out that in nature there is a mechanism of transition from the atomic interaction, through the nanometric state, to a real structure of a certain type. In 1952, Alan Turing mathematically showed that a two-component reaction-diffusion system with diffusion of reaction components and non-linear conditions leads to the spontaneous formation of spatially periodic structures. Experimental embodiment of the Turing reaction showed that under certain conditions, three-dimensional interconnected structures are observed (gyroid, Turing “fence”, etc.). To realize the conditions of the Turing reaction, it is necessary to select reagents that form the so-called cohenetic (heterogenetic) pairs. The best known pairs are diamond (carbon) and silicon carbide. Composites were synthesized using the “Skeleton” technology developed back in the 1960s. (It should be noted that this term is also used for the structural state of silicon carbide grown from the gas phase.)

For the first time, Turing structures in a diamond (carbon) – silicon composite were observed during the synthesis of chromium carbide too. Thus, the theoretical and experimental possibility of implementing the technology of a new class of materials with a regular (periodic) interconnected microstructure based on triply periodic surfaces of minimal energy is shown.

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