

Properties of prenucleation clusters

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In recent years, the problem of existence of relatively stable prenucleation clusters in crystal-forming media, their experimental detection and theoretical interpretation have come to the fore [1, 2]. Long discussions and disputes gave way to the period of detailed analysis and generalization of already accumulated data on the properties of these unusual objects representing a special form of existence of a protomineral substance in the nanoworld, not characteristic of the macroworld.

This report analyzes some special properties of prenucleation clusters, which are called clusters of "hidden" phase or quatarons.

1. Quatarons are limited in their sizes. Their radii range from δ to 4δ . Clusters $r = \delta$ can be formed near equilibrium, and $r = 4\delta$ characterizes the size of clusters capable of transforming into other forms of stable cluster particles, including crystalline nuclei.

2. Crystallization of quatarons is possible if their size is more than 4δ . In this case, they should not be close-packed clusters with non-crystallographic symmetry or fractal clusters. After establishing chemical bonds between atoms, quatarons are converted into large molecules, and with their hollow structure - fullerenes.

3. Quatarons are amorphous structures with a dynamic structure. Because of possible existence of a great number of local minimums (which correspond to different configurations), the form of quatarons is unpredictable, but, on average, quasispherical..

4. Atoms (molecules) inside quatarons can mutually move and rotate, remaining connected with each other. The formation and disintegration of chemical bonds between individual atoms is possible in them.

5. Quatarons are high-energy clusters. A part of the energy, that could release during their formation, remains in them as stored energy. In general, the considered clusters are metastable, not minimized energetically, and not optimized geometrically.

6. By their properties quatarons are ideally suited for the role of building units at the growth of crystals.

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[1] Askhabov (2004) Proc.Rus. Miner. Soc. **133**, 4, 108-123. [2] Gebauer et al. (2014) Chem. Soc. Rev. **43**, 2348-2371.