SOME PROBLEMS OF GENESIS CARBONADOS-LIKE FORMATIONS

Samoilovitch M.I.,[(1)], Petrovsky V.A.[(2)], Belyanin A.F.[(1)],
Sukharev A.E.[(2)], Khitynin V.P.[(2)]

[(1)]JSC CRTI «TECHNOMASH», Ivano Franko Str., 4, Moscow, 121108 Russia
[(2)]Institute geology Komi SC UrB RAS, Pervomayskaya Str., 54
Syktyvkar, 167982, Russia
[*] *Fax: 7 (8212) 245346; E-mail: petrovsky@geo.komisc.ru*

Consideration of solid-state transformations within the framework of classical crystallography, results in reassessment of a role of a disposition as for preservation coherence between crystal phases there are essential restrictions on symmetry of the specified phases whereas for nanostructure it is essentially less than such restrictions [1]. For nanostructured films, in the first, considerably extend symmetry opportunities between nanostructures as phases, and in the second – use of rod substructures essentially changes a picture of coherent interaction between various forms. Transformations into solid-state systems cannot be considered without use of representations about sequence of phase transitions [2]. Conditions of phases in a point of phase transition (PT) of the second sort coincide, but as thus there is qualitatively new condition, phases differ from each other any property of the symmetry which has been not necessarily connected only with change in symmetry of an arrangement of atoms of a lattice. One of problems of the classical approach of consideration PT, is connected to application of the group-theoretical device and with impossibility of use of the local approach without algebraic designs. The last, is, in particular, inevitable by consideration PT for final lattices (nanoclusters) or systems with the fixed number of atoms. In particular, at studying, so-called, superstructures [2] are considered changes of functions of density, invariant concerning rotary transformations without simultaneous translations. The device of the stratified spaces, which some features are stated in work, is used by us within the framework [3] of algebraic geometry and allows not only "to set" laws of assembly nanostructures from generating clusters, but rules of their mutual transformations. Construction invariant from representations of dot groups brings significant restrictions in opportunities of use of the classical approach by consideration PT for nanostructures (final lattices), frequently described non- crystallographic groups. In the present work the specified processes were studied on the modelling diamondlike system submitted by a Si-target, namely features of influence of ionic – plasma processes (in conditions magnetron dispersions) on behaviour surface layers of the specified target were investigated.

For the best understanding of mechanisms of formation of polycrystalline units authors carry out experimental reception of diamond phases by plasma methods. A film of diamond thickness up to 200 microns formed on Si and W substrates from $CH_4 + H_2$ the gas mix activated by the arc category. The sequence of stages of growth of layers is revealed: I - globular (a temperature interval up to ~ 1130 K); II - formation of sides {100} on globule (1130-1180 K); III - geometrical selection, a primary axial structure <100> (~1200-1300 K); IV - formation of secondary conic structures <110> and <111> (1300-1470 K); V - formation of box-shaped forms of growth (> 1470 K). The sequence of stages appeared identical at different temperatures and methods of activation of a gas phase. However, depending on temperature of crystallization these stages received unequal development. The size of areas of coherent dispersion (ACD) of x-ray radiation of diamond corresponds to thickness of the plates forming grains. Size ACD increases from 20 up to ~ 200 nanometers with rise in temperature of a substrate from 1100 up to 1500 K. Similar structure have, in particular, chips natural carbonados [4]. Size ACD decreases with increase in thickness of a layer up to some limit then

becomes to constants. Varying the size, the form and the order of an arrangement of emptiness on a working surface of a substrate it is possible to receive the ordered structures of threadlike crystals of diamond.

Resume

It is possible to assume, that the explanation of solid-state transformations and phase transitions in nanostructured systems is impossible without consideration of the rod substructures [5] resulting in occurrence столбчатых of forms of growth, and their "occurrence" in experimental data (mainly, by results of high-resolution electron microscopy) testifies to necessity of use of the device of the stratified spaces and about impossibility to be limited crystallographic groups for the description of final lattices (nanostructures). By consideration of phase transitions of the second sort, it is natural to count [6], that they are impossible between a crystal material and melt if not to take into account presence of the ordered areas and the conditions described by infinite dot group. The specified data are submitted in connection with that it is possible to assume for lines of conditions to which memories superelastic and possessing property materials, in particular, concern, and also phase transformations of type martensite (which morphology is characterized by presence of rod substructures) are connected to presence in them, as intermediate phases of the determined conditions described, in particular, non-crystallographic groups with infinite dot group.

Work is executed at support of the Russian Federal Property Fund (the project 05-05-64615).

References

1. Samoilovich M.I., Petrovsky V.A., Talis A.L. Diamondlike of structure of new generation // Micro- and nanodispersion structures of mineral substance. - Syktyvkar: the Geoprint, 1999. P. 155-167. (in Russian)

2. Landau L.D., Lifshits E.M. Statistical physics. M.: Nauka. 1964. 567 p. (in Russian)

3. Belyanin A.F., Samoilovich M.I., Semenov A.P. Film of diamond and diamondlike materials: formation, a structure and application in electronics // Materials, the equipment and technologies nanoelectronics and microphotonics. 2003. Ulan−Ude: BScC the Siberian Branch of the Russian Academy of Science. P. 77-180. (in Russian)

4. Experimental modelling morphology growing surfaces of diamond (to a problem of formation of polycrystalline aggregates) / Petrovsky V.A., Samoilovich M.I., Belyanin A.F. etc. // Materials International Conference «Carbon: mineralogy, geochemistry and cosmochemistry». Syktyvkar: Geoprint, 2003. P. 59-62. (in Russian)

5. Samoilovich M.I., Talis A.L. Feature of structural realization of the device of the stratified spaces for nanoclusters as designs of algebraic geometry // Nanotechnology and photon crystals. Kaluga: "TEHNOMASH". 2004. P. 213-229 (in Russian)

6. Samoilovich M.I., Belyanin A.F., Zhitkovskij V.D., Bagdasaryan A.S. Nanostrustures carbon materials in thin-film technology // Engineering physics. 2004. № 1.