area and micro-optic elements. The recording of micro relief images was carried out on films of chalcogenide semiconductors in the mode of photo-structural transformations.

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Grouping of semiconductor materials by degree of atomic structure disorder

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The first practical application of a semiconductor device occurred at the beginning of last century, when a metal-semiconductor contact point was used to demodulate radio signal. However, development of the band structure theory (A. Wilson, 1931) led to explosive development of solid-state electronics, creation of integrated circuits, increasing the degree of integration in accordance with Moore's Law along with a corresponding decrease in the sizes of elements. General direction in the development of solid-state electronics focused on manufacture of devices based on single crystals and on the enhancement of the crystal's structure, since the band structure theory was based on presence of translational symmetry of crystal lattice. The success of the band theory led to the opinion in the last century that presence of translational symmetry is a prerequisite for the existence of semiconductor properties in a material.

However, the discovery of chalcogenide glassy semiconductors by B. T. Kolomiyts and N. A. Goryunova in 1955 [1] showed that the presence of translational symmetry is not a necessary condition for the existence of semiconductor properties of a material, since local order in the atomic arrangement is sufficient for this. At the same time, introduction of the concept of local ordering leads to a number of questions: how these areas are formed, what their sizes should be to preserve semiconductor properties, and how these sizes affect the electronic properties of a material.

Last question is interesting from another point of view. The transition from microelectronics to nanoelectronics at the beginning of our century led to a decrease in the size of active areas of devices to units of nanometers, that is, to sizes comparable to the size of ordered areas in materials in which there is no translational symmetry. This is why the problem of determining dependence of electronic and other properties of semiconductor materials on the degree of their atomic structure ordering becomes urgent. However, to solve this problem, it is necessary to classify semiconductor materials according to the degree of structure ordering first. An attempt to carry out such a classification is made in this report.

Separation of objects according to degree of atomic structure disorder is based on the size of the ordering areas. In this case, existing semiconductor materials can be divided into macro-ordered and nano-ordered. Nano-ordered systems include nanocrystalline materials, non-crystalline (glassy and amorphous) materials, and nanocomposite materials. The dimensions of the ordered regions in these cases lie in the range from single to tens of nanometers [2]. The dimensions of the ordered regions determine the degree of localization of charge carriers. The localization of charge carriers, in turn, determines the mobility and electrical conductivity mechanism in the material. The analysis of the classification presented in the report shows that the adopted method of dividing semiconductor materials into ordered (crystalline) and disordered (non-crystalline) materials does not fully reflect the real situation and needs to be improved. Special attention is paid in the report to consideration of the glassy state of matter and its definition [3].

Acknowledgements

This work was supported by the Russian Foundation for Basic Research (Grant No. 19-07-00021-A).

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Laser-induced periodic surface structures (LIPSS) of amorphous GST225 thin films upon femtosecond laser irradiation

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