INVESTIGATION OF THE LOCAL STRUCTURES OF NATURAL NONCRYSTALLINE SUBSTANCES USING SCANNING PROBE MICROSCOPY

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Despite the abundance of noncrystalline mineral objects in nature, we know very little about their structures because of the absence of long-range translational order in the arrangement of their components. The common approach to their study is finding statistic distribution of metric or topological characteristics within the short-range order (SRO). Noncrystalline substances may have locally ordered elements both at the atomic and higher (molecular and supermolecular) levels. Introduction and advances of new high-resolution methods of direct observation bring us to face the problem of obtaining direct structural information at the local level and constructing on its basis structural models of the SRO and medium-range order (MRO) for roentgenoamorphous substances.In present work, scanning probe microscopy (scanning tunneling and atomic force microscopy) which makes possible observations at the nanolevel (to atomic resolution) in different media (air, liquid) was used in order to study some natural noncrystalline substances of various origins and compositions. My research objects were amorphous carbons from shungite rocks in Karelia; aqueous yttrium phosphate from the Kola Peninsula, Russia; and opals-A from Spain and Australia. Their structures have been visualized at different levels (scales), two-dimensional analysis of the relative positions of the structure-forming elements has been performed using Voronoy polyhedra, statistic distributions of supermolecular elements among linear sizes have been calculated. These distributions have been found to be lognormal for all studied substances. Local geometrically ordered elements arranged in MRO have been shown.