

4.3.13. MAIN DIRECTIONS OF DYNAMIC THREE-DIMENSIONAL ANALYSIS OF NANO-STRUCTURES

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We are living in the three-dimensional changing world. World of micro-nano-objects is just the same. However, for a long time, study of such objects was reduced to obtaining of one-dimensional data (for example, spectra) or two-dimensional projections from static objects.

The development trend in the modern analytic instrument engineering consists in creation of means for visualization of information about three-dimensional morphology, structure and other parameters of a nano-object and their alteration in time in the result of physical, chemical or biological impact. Besides, in recent years, an unique opportunity to simulate or create objects with pre-defined properties, as well as to correct nano-object prototypes created under various methods has appeared.

Purpose of the present paper is to consider possibilities of electronic and ion-beam methods for three-dimensional characterization of micro- and nano-objects in both static high-vacuum conditions and variable environment conditions (including temperature, pressure and chemical composition of surrounding gas or liquid).

Paper will consider the following subjects:

- brief review of the modern state of analysis of nano-objects;
- transmission and scanning electronic microscopy as a visualization means with pico- and nanometric resolution;
- systems with focused ion beam as a means for analysis, simulation and preparation of solid and plastic (including biological ones) objects;
- three-dimensional tomography of micro-objects;
- performance of electro-physical measurements;
- observation and simulation of chemical processes, including ones with nanometric resolution; results of chemical process visualization by physical methods;
- methods of elementary, phase and structural analysis (X-Ray spectroscopy, methods of diffraction and spectroscopy for losses of electron power);
- special surface analysis methods (Auger spectroscopy, as well as photo-electronic, X-Ray and mass-spectroscopy) – last achievements.

In conclusion, it is proposed to discuss modern electronic microscope as a product created by methods of nano-technologies.