4.3.16. APPLICATION OF SCANNING ATOMIC-POWERED SPECTROMETRY FOR NANOPHOTONIC OBJECTS EXAMINATION

Molchanov S.P., Alfimov N.V.,
Photochemistry centre of Russian Academy of Science, Moscow, Russia

Results of examination of nanophotonic objects such as dye molecules, submicron scale microspheres and their assemblies, by means of scanning atomic-powered spectrometry are given in the present paper. This method allows not only visualizing objects under testing in great magnification but also registering their different properties at the same time, which provides a possibility to differ objects of different types against each other.

Unfortunately, the scanning atomic-powered spectroscopy is a less common branch of the probe microscopy [1]. It's root principle is based on registration of a power specter of a probe interaction with the surface and deriving both interaction parameters and "genuine" parameters of a sample. Maps are created and visualized based on parameters of the same type. The scanning atomic-powered spectrometer (SAS-spectrometer) receives fairly large volumes of information on the object under examination (including parameters characterizing electric, mechanical, surface and sorption properties) and performs it simultaneously in one scanning using the same probe (fig. 1).

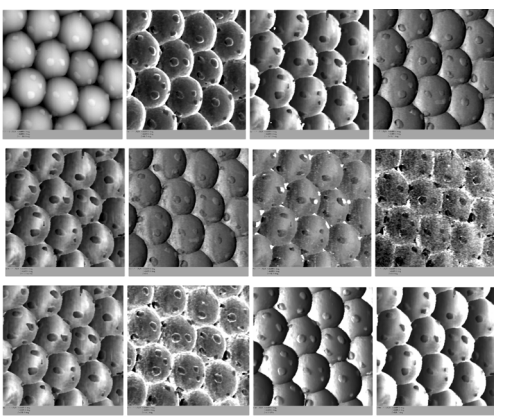

Fig. 1. Data set received by the atomic-powered spectrometer in a single scanning. Images of a photonic crystal surface made of polystyrene microspheres (*d* = 200nm) with dye spots on it. From left to right, downwards:
topography, force gradient map, map of deformation at the moment of a probe detachment from the surface, map of rigidity in stress, surface energy map (according to DMT), map of rigidity without stress, length map of the meniscus lens in detachment of the probe, reverse contact radius map, adhesive force map, gravity force map at the moment of approach, modulus of elasticity map (according to DMT), reverse deformation map in contact. Scanning field 650nm x 650nm

By virtue of a special course of a probe motion above the surface under examination, SAS-spectrometer has greater application capabilities for “complicated specimen”. It is well adapted (without losses in its informational capabilities) to powders, specimen with highly advanced surfaces, low rigidity, covered with absorption layers and other coatings. Absence of a tracking system common for SPM (scanning probe microscopy) eliminates many artifact data and provides ease of its use.

The vital difference of SAS-spectrometer from common SPM modes is the possibility to single out “genuine” parameters of a specimen from registered multicomponent parameters of interaction between a probe and a surface.

Omnitude of provided information and its coordinate compatibility provide obvious results. The possibility to colour topography of an examined spot in accordance with received data (see fig. 2) differs SAS-spectrometer from the modern SPM as a colored photo differs from a black and white one.

The aim of the performed research is to reveal capabilities of the scanning atomic-powered spectrometry for examination of nanophotonic objects. The objectives were as follows: 1) revealing of the methods’ capabilities in differing microspheres (carriers of active centers) with different properties (made from different materials with various surface modification) from one another in multicomponent dry mix assemblies, 2) examination of dye (active chemical centers) spread on microsphere surfaces.

In the paper, capabilities of scanning atomic-powered spectroscopy in differing micro- and nano objects from one another and identification in multicomponent mixes by means of registering different parameters characterizing their peculiarities are demonstrated.

References:

1. **Dremov V.V., Molchanov S.P.** *An Alternative Approach to Using SXM in the Surface Studies* // Сборник статей Международной конференции «STM-99», Сеул, Июль 1999.