Scanning Probe Technology for Surface Structures Characterizations: High resolution in Microscopy and Spectroscopy

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Scanning probe microscopy was born in 1966 in a group national standards Institute USA (Russell young) and began to develop as one of the main methods of research of nanostructures by the original group of researchers of the Swiss branch of IBM, the Nobel prize in physics in 1986, Helmut Binnig and Heinrich Rohrer. The development method has become possible with the advent of personal computers as control systems, instrumentation, collection and processing of the results. The first crucial key innovation proposed by the group of Russell young, has been the use of piezoelectric ceramics for the implementation of mutual displacements of the tip and sample relative to each other.

HD-AFM™ NT-MDT Spectrum Instruments allows to simultaneously investigate the topography, stiffness, potential distribution, the adhesion forces at the lower scanning frequency of 1-2 Hz, the usual for SPM. This significantly simplifies algorithmic measurements, making the possibility of automation for setting the required parameters, which, in turn, dramatically reduces requirements for the qualification of the user. The introduction of new technology can significantly change the consumer properties of the devices and give them new quality devices of wide use for quantitative characterization of nanostructures. In devices NT-MDT SI new mode HD PFM that allows you to explore even loosely associated with the surface of the piezo-active particles.

The appearance of HD-mode and SPM-cartridges allowed to significantly enhance and expand the capabilities of automated devices, which led to the creation of devices NEXT-II (economy version), TITANIUM, VEGA. The instrument design is close to SOLVER-NEXT, but internal design features that made it possible to integrate cartridges and HD-mode into the design of the device. New development - the scanning probe microscope VEGA allows you to work with plates up to 200 mm in diameter and at the same time to obtain atomic resolution, which is ensured by excellent resonance characteristics of the device in combination with a powerful system of thermal stabilization.

The first versions of the instruments of non-permeable IR near-field microscopy were created in combination with atomic force microscopy (Aperturless Scanning Near-Field Optical Microscopy, ASNOM) with a lateral resolution of up to 10 nm. As a source of IR radiation, a CO2 laser with a Michelson interferometer is currently used with the possibility of tuning over the wavelength in the range 10.3 - 10.8 μm. The system makes it possible to detect inelastic scattering caused by the interaction of radiation when the probe is approaching the sample, modulated by the oscillation frequency of the probe against the background of the reflected laser signal. Further development of instruments incorporating the capabilities of atomic force microscopy and spectroscopy involves combining the methods of AFM, luminescent and Raman spectroscopy, and ASNOM with the extension of the spectral range of the latter using cascade lasers, which will yield complex information on both the topography and physical properties of surfaces and the chemical Composition of surface layers.

Consistent innovative development of scanning probe microscopes enabled to reposition these devices greatly reduce the requirements for users of the method of enthusiasts to experts in scanning probe microscopy, and now instruments the latest developments of NT-MDT Spectrum Instruments group of companies can successfully use and technicians, and engineers to operational control processes, and materials scientists, experts, aimed to get a well interpretable information about the physical and physicochemical wasps singularity of the object.