From scanning probe microscopes to smart nanotechnology complexes.

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Time simple scanning probe microscopes it is close to end. As we look to the market there are two tasks: 1. The creation of the complexes which it is possible to reconstruct for the investigation of one or another type of sample; and 2. The creation the special instruments for the decision of some specific properties of sample for concrete application. Next step of the development in nanotechnology analytic and preparative systems instead of the simple SPM are nanotechnology complexes based on SPM methods - NTC.

What is the difference between SPM and NTC? The result of the development of scanning probe technique is the appearance of the group of methods and special devices with the different possibilities and functions:

- Scanning tunneling microscopy & spectroscopy & lithography;
- Atomic force microscopy & spectroscopy & lithography & optical microscopy;
- Magnetic force microscopy - combination between AFM and system for alternating and regulative constant magnetic force action to the sample – tip system & optical microscopy;
- Electrochemical scanning probe microscopy – combination between STM/AFM and electrochemical cell technique & optical microscopy ;
- Scanning nearfield microscopy & scanning force microscopy & optical microscopy;
- Systems for scanning nanoindentation methods & optical microscopy;
- AFM & atomic force acoustic microscopy & optical microscopy;
- Combinations between SPM and optical confocal microscopy and spectroscopy;
- Combinations between SPM and interference optical microscopy;
- Combinations between SPM and SEM and TEM & optical microscopy;
- The investigations at the different conditions – vacuum, liquids, gases, temperature and atmosphere conditions.

After investigations of these methods it is absolutely clear that for a lot of investigation extremely important to have the possibility of investigations of the same sample investigation by a group of methods mentions above. And if it is possible to have the most of the data from the same place of the sample surface and with the minimum difference in time – the result become to be no additive in comparison this the simple sum of individual dates. That is the general reason why very important to have the devices, inside of that it is possible to have the combination of a lot of different nanotechnology methods. We named these types of devices NanoTechnology Complexes (NTC).

Gas – Liquids NTC – Solver-UNI

In comparison with well knowing SPM Solver-P47, Solver-P47H (NT-MDT) or Nanoscope-3 (DI), NTC Solver-UNI include to his line 16 different measuring heads, a line of scanners with the different scan size, capacitance positions sensors for high accuracy of displacement of scanning registration, number of special sensors of atmosphere conditions, and open type Windows SW with possibility of connection different addition devices (spectrometers, lasers, any special electronics boards) by means of their DLL. NTC Solver-UNI can to upgrade by alternative and regulating constant magnet for the tension of magnetic field up to 2000 Oerstedes. In addition to it Solver-UNI can operate as in control gas atmosphere and low vacuum conditions. For vibroprotection for Solver-UNI we use active vibroprotection system “HERSAN” or low resonant frequency (0,5Hz) vibroprotection table “Minus K Technology”. On fig.1 it is possible to see NTC Solver-UNI.

a b

Fig.1. NTC Solver-UNI with SMENA SPM head (a) and the same unit with control atmosphere camber (b).

NTC Solver-HV

a b

Fig.2. Vacuum camber NTC Solver-HV (a) with SMENA-HV SPM head (b) with passive vibroprotection system.

To operate in high quality control atmosphere and to have a line of new possibilities we develop the system in vacuum camber. For high speed pumping we use turbomolecular with out oil pumping system. In addition of a line of measuring heads this device have the possibility of 20 minutes pumping for the 10^{-6} tor, 10K cooling of samples, sources of plasma etching of samples, ion beam and electron beam guns. To use this system it is possible to do profile analysis of sample, to investigate of small forces with more then 10 times in comparison with air sensitivity.

Both complexes will be supply by multiprobe cartridge that is on the development now together with NASCATEC company from Kassel, Zelenograd “Technological Center” and Chernogolovka institute of microelectronic technology RAS.

For the spectroscopy investigation with possibility of micromashining we continue the development special NTC based on NANOFINDER system.

The development of combinations of multiprobe SPM technology with active probes and short impulse lasers will come to the creation of molecular assemblers – new type of technological devices for nanostructures creations. Active probes – means probes with molecular determinate structure on its tips that can change properties to the complexation with clusters or molecule on the surface under the action of any influence (light pulse, electron beam pulse, voltages or some other) to create (for example λ_1 light pulse) and dissociation (λ_2 light pulse) of complexes between tips and molecule. Pulse lasers play the role of the Conductor in process of nanostructure creations.

Nanotechnology intellectual media

From usual XX century device – {Iron + Electronics + Chart Recorder and Scientist with pen and slide-rule} to {Iron + Electronics + Computer and Scientist with keyboard} at the end of the Century that was a way of SPM development. But new Millennium came to us with Grate New possibilities that due to extremely strong development of the communication net. And not only communications but inside of INTERNEN we have the possibility to increase the intellectual ability of devices more and more. Multiprocessor computers, named supercomputers, that can be the brain centers of NTC if both of them will be the part of the Central Intellectual Nanotechnology (CINT) Media. In this case there are no requirements to have all calculation power on NTC work station. Absolutely enough to have multitask SW (operate inside last versions of Windows), INTERNET link and agreement with Global CINT provider (Fig.3).

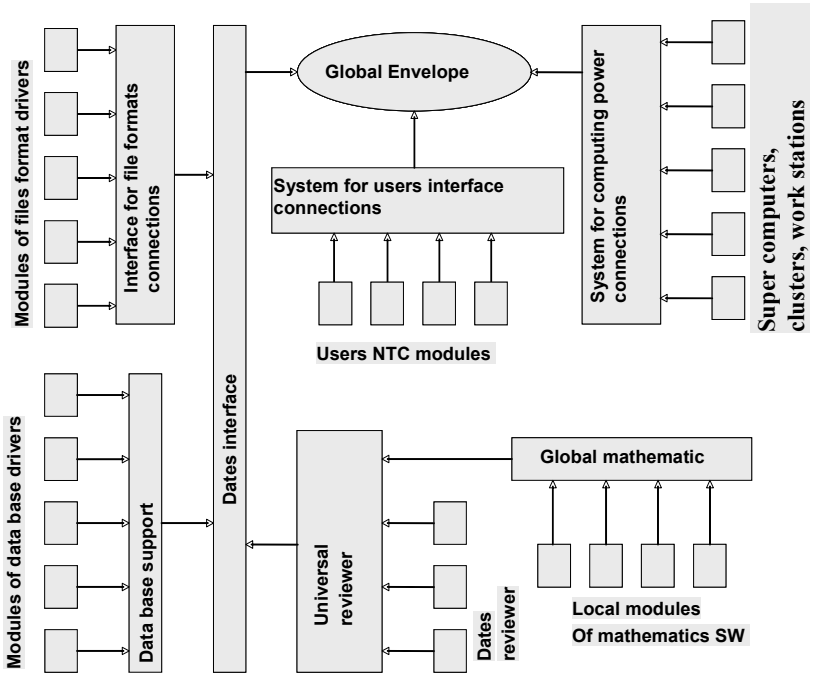

Fig.3. Model of CINT

NTC creation integrated inside of CINT will be developed by financial support of Russian ministry for industry, science and technology in equal part with NT-MDT & NTI money under driving of NT-MDT Co. (Megaproject №2).