60 seconds with ... Authors Edition

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Q: What led you into science and your chosen area of research?

Dr Rostislav V. Lapshin

A: A chance, I believe. A university friend of mine told me about a scanning tunneling microscope and nanotechnology after he had visited research labs at 'Delta' R&D Corp. It was a new challenging field, which I was amazed at and became interested in. The corporation had opened some post-graduate positions. I passed the interview and was accepted. Before that, I had been planning to work in the space industry. Later on however I understood that the scanning probe microscopy gives us a remarkable opportunity to make a kind of space journey - a journey into nanocosm instead of macrocosm. Less expensive, less risky, less time-consuming adventure yet with comparable flow of new scientific data, exciting discoveries and fantastic 'landscapes'.

Q: Can you describe the results in your paper, Rostislav V Lapshin 2004 *Nanotechnology* **15** 1135-1151, **and their importance for your field?**

A: I would note two main results. First, an approach has been demonstrated that considerably increases the measurement precision of scanning probe microscopes. Second, a general way is suggested for building unmanned 'bottom-up' nanofabrication. It's important that the proposed measurement and nanofabrication schemes are no longer a pure 'fantasies', most of them have been confirmed by real experiments. The advantage of the feature-oriented methodology is that the probe instrument operates directly with topography features or surface objects, which usually are the subject of research or technology. As features, for example, there may be taken: atoms, interstices, molecules, clusters, grains, nanoparticles, nanopits, crystallites, quantum dots, pillars, pores and so on. Manipulating with features in the broad sense becomes possible due to a real-time recognition capability intrinsic in the method. It is interesting that unlike regular scanning there is no initially pre-defined probe movement trajectory in the feature-oriented approach. The microscope or a nanoassembler built on its base make their own decision on where to move probe and what to do the next moment. Now, the researcher should only formulate the task in general terms then he acts by the principle 'run and forget'. In order to eliminate drift influence while scanning separate atoms or molecules, the existing instruments should be cooled to very low temperatures 2-10 K. Today, feature-oriented scanning is probably the only active method capable of compensating drift at atomic/molecular scale which gives us the opportunity of operating the device at room temperature. Moreover, feature-oriented scanning permits to achieve high precision and improve resolution of the microscope by averaging a large number of measurements. It is about hundreds of thousands or even millions of averagings. If we continue our analogy with space explorations, the approach is similar to one employed in radio astronomy where a useful signal, negligibly small against the background noise, is extracted by averaging a huge number of measurements.

Q: What research projects are you working on at the moment?

A: At present, I'm busy with improving the feature-oriented scanning methodology. A great deal of work yet should be done before the base principles formulated transform into a precise, reliable, easy in usage, smart, optimally functioning, routine lab practice. Recently, for example, I have finished developing a quite simple but effective technique for drift correction based on counter-scanning and topography feature recognition, patent pending. Such technique is intended for drift correction in segments - small fragments of topography obtained during feature-oriented scanning and used later to reconstruct the sought for surface image. The next projects coming up are: distributed calibration of a probe microscope by natural standards (patent pending), a miniature walking-type robot-nanopositioner compatible with feature-oriented ideology, a technology based on feature-oriented nanomanipulation of substance. By the way, I'm currently searching for partners interested in further development of feature-oriented methodology for both scanning probe microscopy and bottom-up nanofabrication. If someone of the respected readers does or considers designing a similar approach, or has questions, comments or proposals, feel free to contact me by email: rlapshin@yahoo.com

Q: What do you think will be the next big breakthrough in your field?

A: I believe it will be a nanomanipulator also called a nanoassembler. In a few words, this is a specialized probe device able to manipulate with tiny matter quantities like nanoparticles, molecules or even separate atoms in order to assemble rather complex constructions elementwise, bottom-up so to speak. What kind of constructions? Very diverse, from solid nanocircuits to biomolecular systems. The problem, from my point of view, is: how to build such a nanomanipulator that would be precise, reliable, fast and multitool at the same time? I'm certain, we will get the answer very soon.

Q: What book are you reading right now?

A: I am rereading selections from Oscar Wilde.

Q: If you could have dinner with any 3 people, past or present, who would they be and why?

A: French mathematician Pierre de Fermat, so to have the dinner menu designed with proper margin sizes. English physicist Francis Crick, American biologist James Watson and English physicist Maurice Wilkins, to help me tell safe dishes cooked of natural foodstuff from dangerous dishes cooked of genetically-modified forage. German physicist Wilhelm Roentgen: when some of the guests accidentally swallows down a fork taking no notice of that, he will see it through. Russian physiologist Ivan Pavlov, since just a couple of bell rings from him will ensure all the attendants successful digestion of the dinner.

Q: What has been the most exciting moment in your career so far?

A: The most exciting moment? Let me see. I think it was when I took the first scan of disordered surface by applying the method of feature-oriented scanning. It was a nanostructured surface of electrochemically etched aluminum foil. I had taken surface scans employing this method before. But in my previous scans, the sample was a pyrolytic graphite monocrystal and carbon atoms were used as features. During graphite scanning, minimal drifts were acting and the surface itself was rather 'boring', neither advanced was the feature connection method. The goal of the graphite experiment was to demonstrate the method applicability at ultimate microscope resolution. It was shown, in particular, that the work was possible with utmost structural elements of a surface - atoms. Scanning the aluminum sample turned out much more complicated, strange though. The surface was developed, disordered, consisting of features - nanohills of different sizes, significant drifts occurred during the work, even a small modification of plastic aluminum surface took place, scanning time exceeded 18 hours. I remember I left the microscope still running at the end of the workday, locked the laboratory and went home, actually to another town. When I came back the next day, the microscope was still operating ... At last it finished and stopped. I let the obtained data through the surface builder program and got the target aluminum surface topography free of distortions. All the time the microscope was operating absolutely autonomously, it generally had known nothing about the surface. Each time it only 'saw' a small area around, analyzed it choosing suitable features, 'caught' the features following the drifting surface, moved across the surface from one feature to another laying a route, measured relative distances between features and scanned surface segments, picked up and accumulated surface statistics. It looked as if you sent an exploration rover to another planet; it landed, walked around, unattended, at an unknown surface avoiding obstacles and accurately conducting the required measurements, and then transferred to you what it had seen