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From Russia with Love: Next-Gen Modular, Hybrid Nano Tools

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An interview on global trends in nanoscience instruments and education with 30-year veteran Barbara Foster, President Microscopy/Marketing & Education, Inc. Foster shares why Russia offers innovative new tools, and some broader lessons for nanoscientists.

Last month, Russian President Vladimir Putin put nanotechnology right at the top of spending priorities for his country – only housing and roads were more important. Many nanoscientists may have briefly raised an eyebrow, and then peered back into their microscope. But, one nanotech expert familiar with Russia says we should take more notice and even take a lesson or two.

Nano World News talks with Barbara Foster, a strategic consultant for the microscopy and imaging world, whose key client, Nanotech America, is the North American distributor for NT-MDT, a leading Russian device maker. Ms. Foster shared why Russia has lessons and tools that could help take U.S. nanoresearchers into the future.

“Modularity and hybridization are two key trends driving the latest in nanotechnology instruments,” Foster told Nano World News. “When you think about it, the reasons are obvious. Scientists are learning more about the fundamentals of their own areas of nanoresearch, but the way to move to the next level, including commercialization of new nanotechnologies, is to reach out and work with those in other disciplines,” Foster said.

All across nanoscience, Foster said she sees more frequent examples of multi-disciplinary work, where professionals from chemistry, biology, physics and even electronics are recognizing the need to work with each other. But, it’s not always that simple. She observed that “in the US, we’ve tended to compartmentalize our science. One group may have a specialty tool that works for them, but if scientists are focused just on their specific discipline, they might not be aware that the same tool can solve their problems. In other parts of the world, scientists tend to see things from a more integrated perspective, and that’s an important lesson for us to learn.”

“For instance, “ she went on, “for over half a century, there has been a schism between imaging and spectroscopy.” A graduate level chemist by training who came to microscopy as a second career, she is part of a rare group who straddles both arenas. She has also worked inside the imaging industry, including being a technical marketing manager for Zeiss and Cambridge Instruments (now part of Leica), and as president of her own nanotech and biotech consultant firm Microscopy/Marketing & Education, Inc. (Allen, TX), she fully understands the business implications of bringing these two technologies together.

“This schism meant chemists worked in a black-box. They rarely watched their analyses or experiments at the real-world, micro level, leaving the results open to misinterpretation. Nanoscience is changing a lot of that. We’re seeing new demand convergence of technologies that are literally opening the eyes of researchers, engineers, and analysts. Light, Confocal, Electron (SEM and TEM), and Atomic Force (AFM)

microscopies are colliding with FTIR and RAMAN spectroscopies, all driven by new, often 3D, imaging software to form new tools and platforms."

One of Foster's clients, Nanotech America, Inc., imports atomic force microscopes for the U.S. and Canadian markets from NT-MDT, a leading Russian designer and manufacturer of next-gen nanotechnology tools. " AFM is THE technology for nanotech and NT-MDT leads the field with modular and hybrid tools for nanoscience," Foster said.

She notes that these devices and their derivative tools are enabling new directions in multi-discipline nanoresearch in Russia and other key labs in the world. As a result, Putin has tapped Dr. Victor Bykov, NT-MDT's founder, as a commercial advisor to push nanoscience initiatives in Russia. "From our interactions with Victor, we've learned about Russia's aggressive nanotech building program. For example, Dr. Bykov was a key speaker at the 2005 inauguration of the Center of Nanotechnology and Institute for NanoPetrography in Khanty-Mansiysk, a gorgeous glass and steel building with very high security, located in the frozen heart of Siberia."

NT-MDT's Nanotech Instruments - Available from Nanotech America

Two key NTMDT microscopes embody the new directions in nano-level analysis. The NTegra Spectra marries Raman spectroscopy to AFM, and NTegra TOMO unites AFM with microtomy. These two devices also offer a glimpse into how Russian nanotechnologists define their growing need for convergent capabilities.

Let's take a detailed look:

- The **NTegra Spectra** integrates AFM and Raman, and is built around a high-resolution Solare spectrometer and the modular NTegra AFM. The design offers motorized controls for the confocal apertures; a choice of 3 different lasers; and multiple dichroics. The device's integrated approach even extends to its support software. All the NTegra Spectra options can be managed through the same software (called Nova) that runs the AFM. In fact, in total, the NTegra Spectra's Nova software provides control to both light and more than 40 different AFM/SPM modes, and both confocal Raman and fluorescence spectroscopy. Furthering the modularity theme, the NTegra Spectra fits onto an Olympus IX-71 microscope to support transmitted light applications and near-field scanning optical microscopy (NSOM).
- The **NTegra TOMO** creates a new hybrid between AFM and ultramicrotome capabilities for preparing samples and imaging ultrastructure without staining, enabling both 2- and 3D nanotomography. By imaging from the block in which the sample is mounted rather than a cut slice which needs to be moved to a microscope, TOMO dramatically reduces typical sectioning problems such as stretching, wrinkling, or distortion. Based on a Leica UC-6 ultramicrotome, it can prepare slices as thin as 10-15 nm. Since the AFM is integrated directly within the UC-6, researchers can do multiple serial images. Importing these sections into programs such as Media Cybernetics' 3D Constructor creates exciting and dynamic 3D images without the usual excruciating and labor-intensive alignment process. "TOMO really drops the barriers to 3D imaging. Researchers can actually see what's going on, rather than relying on mathematical models," Foster said.

Broader Trends, Deeper Lessons

Beneficiaries of these new tools reach beyond academia and into commercial labs. Foster cites a leading printer company designing a new kind of ink, and a famous athletic shoemaker who wanted to see the structures of their new nanoscale materials. "There is a structure-function relationship that until now has only been visible with mathematical models in 3D. Our customers are now seeing things they've never seen before."

But to Foster, the more important point is that these modular and hybrid tools are helping expand research dollars inside academia. "Modularity means that one department might buy a base and one component, and researcher or professors in another department will buy an add-on module to meet

their unique needs. We've recently quoted to one university with the core going to one researchers and four other modules going to 4 different departments. The microscope became a real shared resource, rather than requiring each to have its own stand-alone device," Foster said.

And, modular also means mobile. "Over the past year we've begun offering just the core scanner, which lets researchers scan at the desktop -- or even more interestingly, lets them go into the field to look directly at nanostructures on an aircraft wing, locomotive or whatever interests them." AFMs operate on the concept similar to a phonograph needle reading a record: as long as the record is not moving, the sound is great. Similarly, as long as the sample is not vibrating, the images will be great. In the lab, the scanner sits on a special base, built for extreme stability.

At a price tag starting at $50,000, the NTegra line also "makes a great teaching tool," Foster said. And for Foster, that's not just a sales pitch: She taught for 15 years before launching into her current career.

She truly believes that we need to do better with science education and teaching. "That's another other lesson we can learn from Russia," she said. "For over a quarter of a century, I've worked with multi-national companies and end-users in many different fields of science. My dad was a scientist in the Manhattan Project and I was in high school when John Glenn first orbited the earth. As a consultant, I've been privileged to work on the cutting edge of biotech and nanotech. From that global perspective, I am extremely concerned about our ability to stay competitive in science. The U.S. needs to re-focus and invest strongly in science education. While I am very enthusiastic about nanotechnology's ability to deliver on the future, it will take strong educational programming and serious financial commitment in science education for the U.S. to remain a key player."

For more information:

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