

Nano World: Nano-tool markets rising

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The market for tools used to fabricate emerging nanotechnology could grow from less than \$20 million in 2004 to nearly \$235 million by 2010, experts told UPI's Nano World.

At the same time, the market for instruments used to inspect matter on the nanometer scale, which currently dominates the \$580 million nanotechnology tools market, is expected to see only tepid growth, although still command more than \$750 million in 2010.

To size and forecast the market for tools for emerging nanotechnology over the next five years, excluding established uses in fields such as semiconductors and data storage, nanotechnology analysis firm Lux Research in New York confidentially interviewed chief executive officers and marketing executives at 21 leading tool vendors worldwide and research and development leaders at 49 companies, universities and national labs active in nanotechnology.

Nanotechnologists use three kinds of instruments to experiment with matter on the nanometer scale. Inspection tools such as atomic force microscopes and electron microscopes visualize nanometer-sized objects and represent the most mature and widely used category of tools for emerging nanotechnology. Fabrication tools such as nano-imprint lithography and dip-pen nanolithography create structures at the nanometer scale. Modeling tools are programs that predict nano-structure properties to circumvent the costs and time associated with experiments.

In general, Lux predicts the nanotechnology-tools market will see a compound annual growth rate of 11 percent to nearly \$1.1 billion in 2010. However, growth will not prove even across each of its market segments, Lux Research analyst Michael Holman said.

The current market for nanotechnology tools is dominated by inspection tools, which accounted for 95 percent of the 2004 revenues. The inspection-tools market saw dramatic growth during the early 2000s nanotech explosion, Lux Research analysts found, when many university nano centers were constructed. However, the growth outlook for inspection tools looks slow because the university and lab markets are now saturated.

"There's an expectation that nanotech inspection tools will see a big boost from being adopted by nanomaterials manufacturers for quality control in the factory," Holman said. "But the nanomaterials manufacturers we spoke to tell us that faster and cheaper alternatives are available for routine quality control, and that they only need inspection tools like scanning probe microscopes and electron microscopes for process development and spot checks. When these companies begin shipping products, they don't see the need to buy new tools beyond what they already have for R&D.

"At least one major materials and manufacturing company in the United States we spoke to has already begun outsourcing analytical services to a research center in India," Holman added. "When we spoke to users about the expense of owning and maintaining inspection tools, the biggest expense is the fact you need to hire and pay a highly trained scientist to successfully operate it, and there's big opportunity there for outsourcing."

Outsourcing inspection sounds like it could be a good idea, "but if you look at how manufacturing is done now, normally you have inspection

protocols pretty close to the production line, and while I can see the draw of outsourcing, I'm skeptical it will necessarily catch on in critical application areas," NanoBusiness Alliance Executive Vice President Nathan Tinker said.

Fabrication tools have currently not found commercial uses. Still, Lux Research expects these instruments to gain traction over the next five years and move beyond R&D labs to manufacturing floors. In particular, Lux Research sees nano-imprint lithography as the favorite, which acts much like a miniaturized rubber stamp to lay out features as fine as tens of nanometers on surfaces. "It's mooted for a wide variety of applications: everything from making optical media like CDs and DVDs, optical components like beam splitters, patterned hard drive media and integrated circuits," Holman said.

On the other hand, Lux Research felt dip-pen nanolithography, which uses atomic force microscopes much like quill pens to draw nanometer-sized features on surfaces, faced sharp resistance. "A lot of people find it interesting as a research tool, but in many cases they would much rather have a kit to modify an atomic force microscope they already own rather than purchasing a whole new instrument just to do dip-pen," Holman said. While leading dip-pen nanolithography company NanoInk in Chicago is working with IBM on an improved multiple-pen system, Holman did not anticipate wide use for dip-pen nanolithography in production by 2010.

Modeling tools claimed less than \$10 million in 2004 in the face of entrenched skepticism from potential customers. In five years Lux Research expected that market to expand to only roughly \$40 million, a small fraction of the total nanotechnology-tools market. Still, in a decade the analysts predicted it could break \$100 million as power, accuracy and ease of use of modeling tools continues to improve and more customer success stories emerge.

Lux Research also expects San Diego-based Accelrys, a \$160 million market-cap company and nanotechnology modeling tools leader, to partner with or gobble up one or more of its competitors such as Copenhagen-based Atomistix and McLean, Va.-based nanoTITAN, which are generally startups, "to bring in technology or co-opt the competition," Holman said.

In the near future the emergence of standards for nanotechnology components and devices could also help drive the nanotechnology tools market "with tools created specifically to match those standards," Tinker said. Also, the increased confidence in nano-materials that standardized products would raise in electronics companies and other potential nano-materials customers should drive up demand for those nano-materials, "which in turn stimulates the tool market again," he added.

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