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EMBRACING DISRUPTION: DESIGNING THE FUTURE

Nanotechnology: The Next Big Thing

Industry Profile

MultiSource Manufacturing LLC

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Who's Who

Tom Daggett

Hutchinson Manufacturing, Inc.



NANOTECHNOLOGY: THE NEXT BIG THING

by Lynne Osterman

Nano is a prefix that comes from the Greek word meaning “dwarf,” and is used to describe units of measurement that are “one-billionth of” something else. For example, a nanometer is one-billionth of a meter, or 0.000000001 meter (1/25,400,000 inch).¹ At least one dimension of an object is between 1 and 100 nanometers long to be considered “nanoscale.”

Nanoscale science is the study of the behavior and properties of nanoscale objects, often conducted within research institutions such as the University of Minnesota. Nanotechnology uses nanoscale science to manipulate individual atoms, molecules or nanoscale objects to create larger objects. Nanotechnology includes devices that measure the size of or take pictures of nanoscale objects, create other nanoscale objects, and fortify or improve macroscopic objects (things we can see with the naked eye).

In other words, the application of nanotechnology allows us to view existing things at nanoscale, create new things, and improve upon old, existing things. If you’re a company that creates things, this disruptive technology offers a host of potential uses. And if you’re a company that manufactures the things your customers create, the time is now to jump into the nano world!

The NanoBusiness Alliance, based in Chicago, credits a speech by former President Bill Clinton at the California Institute of Technology on January 21, 2000, with igniting a broad and aggressive vision for nanotechnology research and development that would go beyond the work already then underway in federal government, university and corporate laboratories. Clinton’s talk led to the creation of the National Nanotechnology Initiative (NNI).

The 2010 federal budget provides \$1.6 billion for the NNI—up considerably from its original appropriation of \$700 million per year, with 25 government agencies participating (up from the original seven agencies). Recently, the NNI called for states to establish their own strategies for nanotechnology utilization.

MN Nano, a statewide association for the use of nanotechnology to advance Minnesota’s competitiveness, currently is assembling a team from Minnesota, Wisconsin and North Dakota to develop a regional strategy. Their strategy development work is expected eventually to expand into Canada as well as Iowa, Illinois and South Dakota.

MINNESOTA’S BUSINESS APPLICATIONS ARE VAST

Manufacturing, health care, consumer products, computing and

electronics, food and agriculture, energy and the environment, among other sectors, all will realize significant alterations due to nanotechnology.

A May 2010 showcase co-hosted by MN Nano and LifeScience Alley at Medtronic’s Mounds View campus featured numerous companies sharing how nanotechnology is a major part of their planned business growth: from Medtronic to 3M to Surmodics to Douglas Scientific (a young venture co-located at the site of well-respected employee-owned Douglas Machine in Alexandria).

Douglas Scientific was initiated to capture marketshare in an area utilizing nanotechnology, including biofluidic dispensing, polymerase chain reaction (PCR), reagent testing, and scanning. Douglas Scientific is capitalizing on needs within the marketplace as well as capitalizing on its parent company’s historic reputation for engineering and building machines. The company produces machines that use a “tape” with customized embossed wells, an innovative and modular platform with flexibility to address a wide range of laboratory processes.

Another presenter, Corey Radloff, senior research chemist within 3M’s materials laboratory, said various divisions within 3M are actively at

PROPERTIES OF MATTER—PHYSICAL AND BIOLOGICAL—ALWAYS HAVE BEEN ORGANIZED AS SYSTEMS OF ATOMS AND MOLECULES. IT'S ONLY BEEN IN THE PAST 20 TO 25 YEARS THAT WE ARE ABLE TO MANIPULATE THE ORDER OF HOW THE ATOMS AND MOLECULES ATTACH THEMSELVES TO ONE ANOTHER, BECAUSE THE ADVENT OF POWERFUL MICROSCOPES GIVES US THE OPPORTUNITY TO SEE THINGS AT THE NANOSCALE.

work utilizing nanotechnology as a key technology platform. Examples include increased capability for energy transmission, with cables transmitting two to three times the energy and with steel that is less than half the density of its older cables; multi-layer optical films for use atop screens such as cell phones; enhanced capabilities and applications for fuel cells; and nanoparticle use in dental restoratives that mimic the density, strength and surface characteristics of natural teeth. 3M also is actively reviewing products currently on the market to determine how nanotechnology potentially can improve either the manufacturing process or the products themselves. Controlling the very essence of a product's structure gives companies quite a lot of flexibility.

Also included in Minnesota's nanotechnology "toolbox" are sophisticated measurement tools designed, engineered and manufactured by Hysitron, an Eden Prairie company fluent in "nano-speak" for almost 20 years. Hysitron's tools can be custom-designed so its customers' specific applications can be realized, including biological, ceramics, composites, MEMS, metals, polymers and thin films.

HOW DO CONTRACT MANUFACTURERS GET INTO THE NANO SWING OF THINGS?

Well, for starters, it kind of comes down to terminology, according to Top Tool Company's technical sales support lead, Duane Kari. "While not currently in nano, we're just above that with precision 'micro-component machining and stamping.' We do see customers requesting work at the micro-miniature level, which has required us to combine stamping technologies that have been around for years with custom solutions to meet their micro-level needs."

Kari asserts that classification of "micro" versus "micro-miniature" versus "nano" will continue to be an exercise for contract manufacturers, as they work to determine what it is their customers actually are requesting. "There's no doubt we are being pushed to get smaller and smaller," continued Kari. "Top Tool is employing technology via an electronic discharge machining (EDM) center that uses spark erosion to cut metal [any metal that conducts electricity], a capability that currently makes us somewhat unique in the Midwest. This particular EDM system is one of only four online in the United States. We've invested in training specific to this new tool (as well as new concurrent measurement capabilities). When you couple that with our over 40 years of tool making and metal stamping experience, we can leverage our contract manufacturing know-how to be a complement to what today's customers—and future customers—say they need to meet their growth plans."

ARE WE "GROWING" A WORKFORCE PREPARED TO WORK WITH NANO-SCALE REQUIREMENTS?

When the Dakota County Technical College (DCTC) seemingly "scrapped" its machine tool technology programs a number of years ago in order to make room for a nanoscience technology program, many heads were turned. What then was thought a gamble has proven to be a sure bet and DCTC president, Dr. Ron Thomas, is delighted at how things have turned out. "This program has been nationally recognized and we see its value in the community," said Thomas. "That value will surely increase dramatically

as businesses further embrace nanotechnology, and as prospective students make the connection between this opportunity—for job preparation and the future economy."

DCTC's nanoscience technology program has been directed by Deborah Newberry, whose background includes 23 years in the corporate world in nuclear physics, chemical engineering and mechanical engineering. "Industry is who we work so hard to satisfy—if there are certain skills they need, or they're not even necessarily sure today how nano will impact them but want to consider how those needs will evolve, we want to hear from them," said Newberry.

A committed partnership with the University of Minnesota's College of Science & Engineering "has been a key to attracting students, and corporate partners, to our program," Newberry explained. "University of Minnesota professor/researcher Dr. Steve Campbell, director of the Nanofabrication Center, has been instrumental in our ability to offer students a comprehensive experience. Our students are able to avail themselves of equipment and expertise the university offers, while completing a 2-year program. That combination has really hit the mark, according to the feedback we gained from prospective corporate partners as we designed our program, as well as how they've responded by hiring our graduates."

MPMA is working closely with MN Nano to help Minnesota's precision manufacturers position themselves to support the nanotechnology needs in Minnesota. Please visit www.mpma.com to take a brief online survey which includes a section of feedback on nanotechnology knowledge within the Minnesota manufacturing industry. This will help MPMA determine which areas to best support the industry. If you are interested in learning more about how your company can get involved with nanotechnology, please contact jaimem@mpma.com. PM

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1 - Science Year: The World Book Annual Science Supplement," 2007, Angela Berenstein and Albert H. Teich.