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Breakthrough enables world's smallest robots;
nanotools capable of manipulating large molecules and cells

New patented electron-beam 'micro-robot' technology based on
'memory' metal helps fulfill Feynman's nanotech dream*

Rochester, NY and Los Gatos, CA; July 17, 2003—Technology Innovations, LLC and Innovation On Demand, Inc. announced today that they have been issued U.S. Patent No. 6,588,208, "Wireless Technique for Microactivation" (innovation-on-demand.com/nano.pdf), by the U.S. Patent and Trademark Office.

This pioneering patent covers microactuators (tiny devices that control microscopic objects) that can be operated wirelessly by focused beams of energy, enabling the devices to control objects in the nanoscale range -- as small as 100 nanometers (billionths of a meter).

"These microactuators fill the huge gap between millimeter-size (thousandth of a meter) actuators at the high end and scanning-probe-microscope atomic manipulators at the low end, which are limited to moving individual atoms and small molecules slowly around," said inventor Ken Clements, CEO of Innovation On Demand Inc. and partner in the development of this technology with Technology Innovations.

How it works

The breakthrough is the combination, for the first time, of two key technologies:

Heat-actuated shape memory alloy (SMA) microactuators. These use special metal alloys that return to a "memory" state when heated. They eliminate the need for chips, batteries, and other bulky devices, allowing for actuators that can be miniaturized down to the low-micron (millionths of a meter) range. These microactuators, which are created from an SMA thin film, can be designed to manipulate objects as small as 100 nanometers in the nanoscale range.

Electron-beam or photon-beam heating. These beams send directed energy (for heating the SMA element) to the microactuator (micro-robot), replacing the bulky wires and batteries formerly required. They allow the micro-robot to be sized as small as 2 microns wide by 10 microns long -- 50 times smaller than what's feasible with current microactuator technology. In addition, a scanning electron microscope (which creates the electron beams) can be used for visual feedback and control, which will be covered in additional patents that are pending.

New nanotools and markets

"Wireless SMA actuators provide a foundation technology for the creation of a wide range of nanotechnology tools that can be powered through the use of laser-based or electron microscopes," said Michael Riedlinger, Vice President of New Business Development for Technology Innovations. "We are seeking the participation of other firms and research organizations for expanded development and commercialization of this enabling technology. We envision many new innovations to stem from our pioneering patent and new ventures making specific wireless microactivation tools under license."

SMA microactuator technology uses include construction and control of medical devices such as valves and stents, microsurgical instruments, miniaturized manufacturing molds, and manipulation of proteins and genetic components.

Working samples of this technology have been created by Clements and TiNiAlloy (www.sma-mems.com), a world leader in shape memory technology. The samples were made using shape-memory material sputtered onto tiny substrates and actuated with a scanning electron microscope. Photographs of the original proof-of-concept actuators are included in the issued patent and in a paper by Clements, David Johnson, and others at TiNiAlloy (innovation-on-demand.com/tini.htm).

"Ken Clements and TiNiAlloy are available to help develop and implement specific solutions using the technology and we are seeking collaboration and licensing arrangements with third parties with applications requiring wireless microactuation," added Riedlinger, who can be contacted at Technology Innovations, (585) 214-8000 or mriedlinger@tillc.com.

Technology Innovations, LLC, based in West Henrietta, NY, near Rochester in the High Technology Rochester technology incubator, owns and develops technology innovations in diverse fields, including electronic publishing, sputtering technology, and nanotechnologies. The intellectual properties developed by Technology Innovations with leading scientists and inventors are then licensed to third parties or provided to new ventures spun-off from Technology Innovations. These include Biomed Solutions, LLC and Biophan Technologies, Inc.

Innovation On Demand, Inc., based in Los Gatos, CA, develops cutting-edge technology in the computer and microelectronics industry and provides "scheduled invention" services. Its substantial experience in machine control and wireless technology is being directed into the new field of nanotechnology to develop the tools and infrastructure needed to construct novel machines at the large-molecule scale. "Innovation On Demand" is a registered trademark of Innovation On Demand, Inc.

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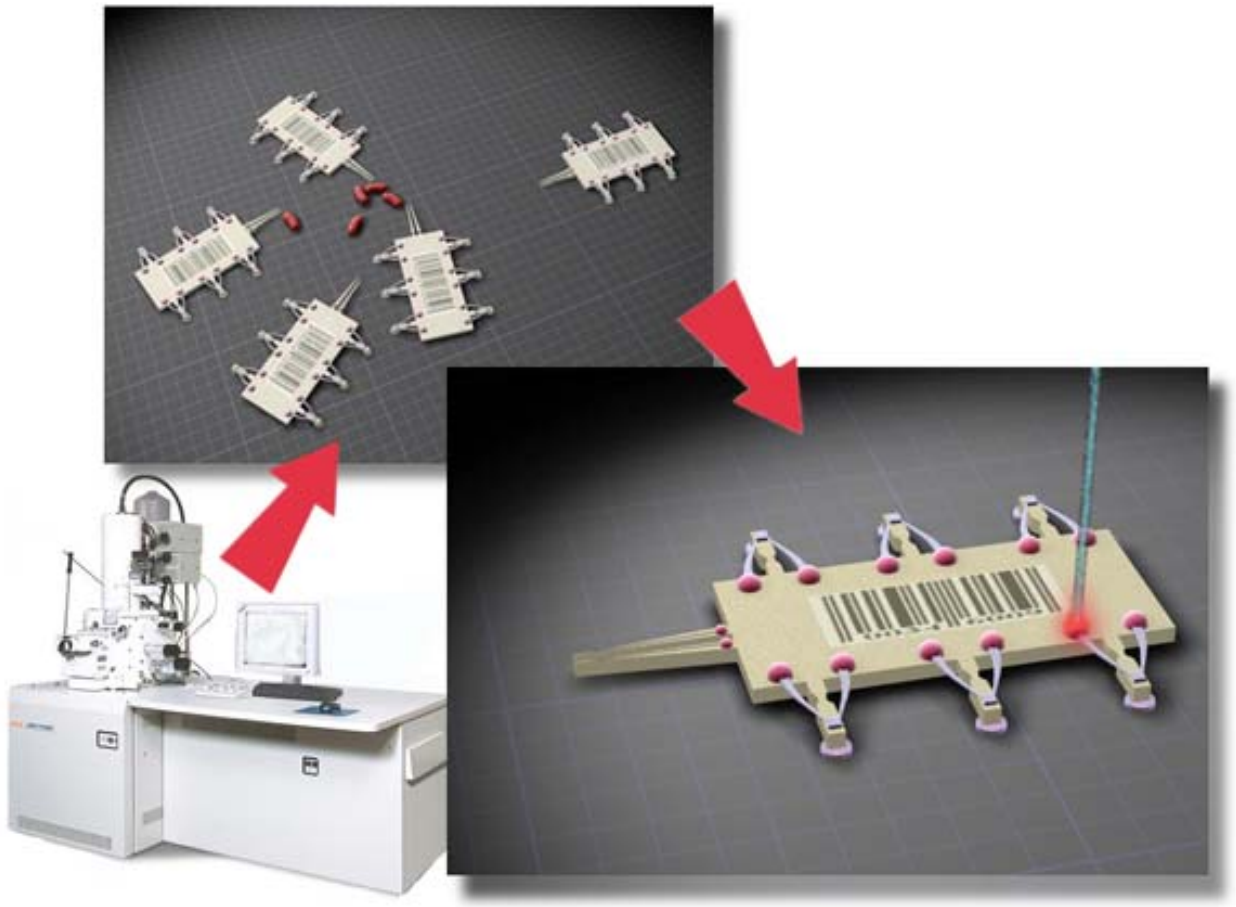

(**Click image for full-size illustration)**

How shape-memory alloy micro-robots will work (artist's rendering)

The world's tiniest robots are controlled by powerful beams from a scanning electron microscope (SEM) or laser that wirelessly heats up shape-memory alloy elements in micro-robots, allowing them to "walk" or grip and manipulate nanoscale objects. Because of its beam agility and heating energy, under CAD (computer-aided design) program control from a PC, a single SEM can control multiple micro-robots engaged in a variety of biomedical and biotechnology research, nanomanufacturing, and other tasks. The same SEM can also visually monitor micro-robot actions for a high-precision, closed-loop feedback system.

* See **Wireless technique for microactivation: Technical Backgrounder (**http://innovation-on-demand.com/microactuatorstechbk.pdf)