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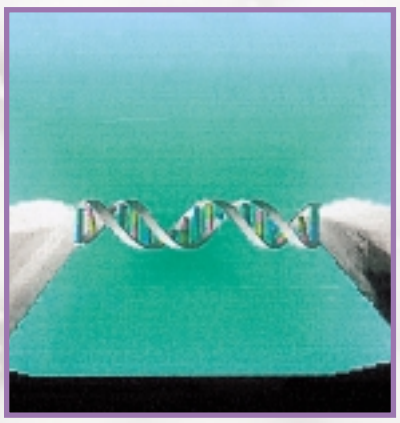
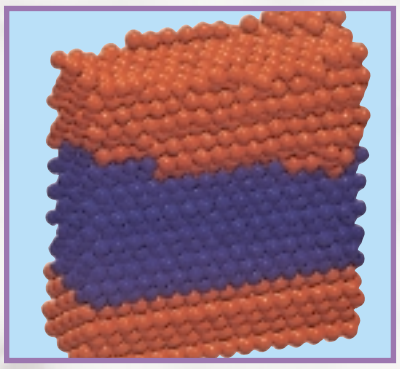
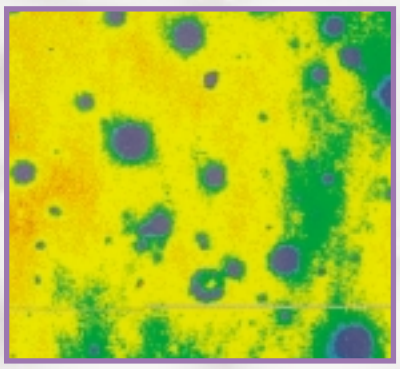
ISRAEL PLANNING FOR BRIGHT NANOTECH FUTURE







By shrinking devices to near atomic size and by manipulating new materials on a billionth of a meter (nm) scale, nanotechnology promises to revolutionize our world, both scientifically and – given the many potentially lucrative applications – economically. The existence of many known, and as yet unknown, quantum effects and formidable practical challenges will require major sustained intellectual inputs from both the academic and industrial research communities over the next 10-20 years. The cover article in the last edition of *The FORUM* – the first in a series – described how the early involvement of Israel's research community, often funded by the Israel Science Foundation (ISF) and other programs initiated by the Israel Academy of Sciences and Humanities, helped provide the firm foundations needed to place Israel in a favorable position for further rapid growth. This article discusses the next logical step in moving Israeli nanotechnology from the laboratory towards the marketplace.

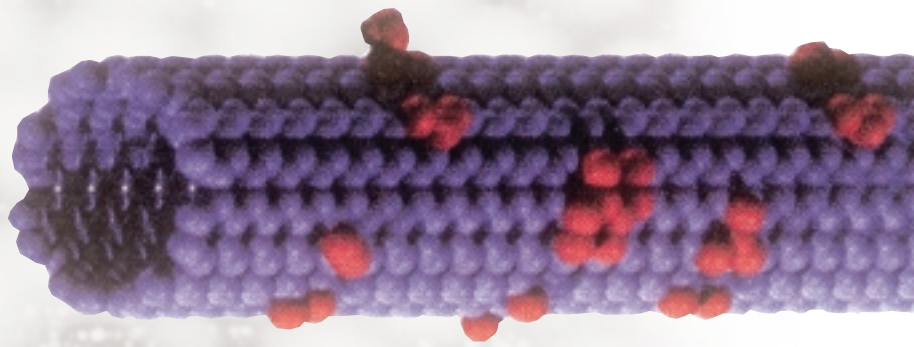
With new commercial products increasingly within grasp, tighter synergistic partnership between academia and industry has become crucial in this highly competitive field (several hundred billion dollars of products are anticipated over the next decade). To accomplish this, Israel's high-level TELEM coordinating group (see *The FORUM*, Summer 2002) appointed a special broadly based national Nanotechnology Committee (NC), chaired by Dr. Dan Maydan of Applied Materials, Inc., to:

- Survey Israel's international position and potential in nanotechnology
- Survey Israel's existing and required nanotech infrastructure, and its location
- Develop a specific masterplan for a new Israel Nanotechnology Program (INP), for TELEM's discussion and potential implementation.

The NC's exceptionally well-crafted final report and recommendations were submitted to TELEM on October 1, 2002.

First, where does Israel stand? According to a recent European Commission report (available at stacks.iop.org/Nano/13/243), in absolute terms, the USA, Germany and Japan jointly dominate both nanotech publications (47% in 1997-99) and patents (70% EPO or PCT patents) although, surprisingly, Israel ranks twelfth in the world in patents (100 patents, 1.1% of the 1991-99 total). Normalizing the data by population provides an even bigger surprise. Israel is second in the world in nanotech publications (91 per million) and third in patents (3.9 per million). This implies an exceptional Israeli ability to innovate publishable nano-science and translate it into patentable technology. What would it take to go the final step and further develop these discoveries into internationally competitive products? And what would it take to keep this self-reinforcing three-stage engine humming?

According to the NC, one main ingredient is focus. Israel's small absolute size requires concentrating its human and financial resources on a few selected areas in which it can efficiently reach a "critical mass." Government, academic and industrial partners must then work together on what each can do best. Since Israel lacks a natural civilian "leading user," catalytic government funding, coordination and initiative are essential. Israel nanotech already has over 100 key researchers and $80 million in buildings, salaries and equipment, but it has barely considered the much larger amounts required to "productize" its innovative initial research. Even more telling, it lacks a national nanotechnology policy to provide overall direction. One of the NC's first recommendations is to establish such a policy, and soon.

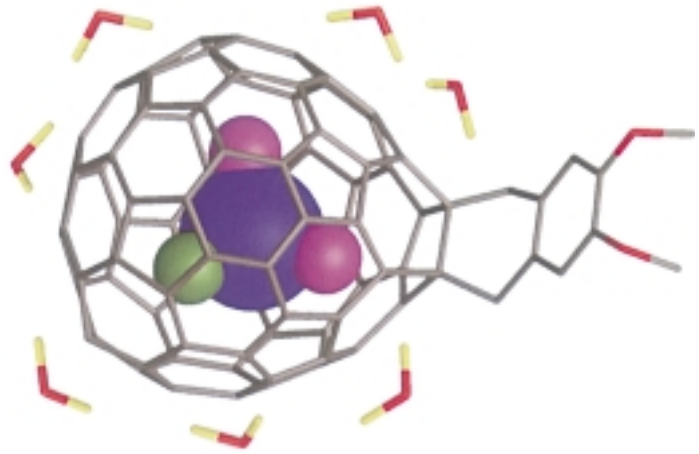


In their view, Israel should leverage its existing strengths and capabilities to exploit specialized, but not necessarily mainstream, opportunities. It should avoid well-trodden paths in which more massive global efforts could overwhelm its intellectual advantage. Governmental user agencies could provide the necessary "pull" – which cannot be provided by Israel's small domestic market – via funding, participation and guidance, to focus and accelerate development.

The NC report includes highly specific goals, budgets and procedures for a 5-year, TELEM-initiated Israel Nanotechnology Program (INP). Within 5 years (2003-2007), the INP should double the annual number of Israeli nanotech graduates to 40 a year, promote the filing of 200 new patents (100 in research, 100 in development), catalyze $20 million of local industrial funding, help establish at least five nanotech startups (each with $30 million or more in venture capital funding), and get 750 Israeli employees involved in nano-related business. Israel's academic nanoresearch priorities should concentrate on nanomaterials, nanobiology and nanoelectronics. Interesting "niche"-opportunities include biological sensors (including those to combat nonconventional or terrorist attacks), functionality detection, drug and vaccine release, target-seeking "smart" medicines, optical switches, fast laser telecommunication, biocompatible surfaces, molecular-imprinted nanoparticles, gene therapy, "lab-on-chip" systems, active filters, and nanocatalysts. Technological priorities include these, plus energy and water desalination applications.

The INP's recommended 5-year budget would exceed $300 million. Initial funding would come from many different sources: TELEM member organizations, institutional matching funds, industry, and international cooperation. The INP would devote about $25 million to university infrastructure, $15 million to industrial projects and $100 million to industrial infrastructure. The $100 million earmarked for national nanotechnology prototyping facilities, a crucial link, would benefit both sectors. Oversight would be provided by a multisectoral National Nanotechnology Board (NNB). Israel's academic community is expected to fund about $75 million of nanotechnology research, using private and competitive grant funds, over the same period.

At its recent October 2002 meeting, the TELEM broadly endorsed the NC report and, in accordance with it's recommendations, they are forming an NNB and have committed themselves to providing $25-30 million over 5 years to help catalyze implementation. Their landmark decision is expected to have a major impact on Israel's R&D focus and future economy. The NC report itself noted the importance and magnitude of this task, asserting that, "Nanotechnology can and should become a core driver of academic and economic progress in Israel. Realizing this vision will entail new roles for academia and industry, clear organization, increased funding, tight collaboration and a serious approach to oversight and implementation." In return, such a broad-based initiative "should allow Israel to reap significant rewards for years and decades to come."



ISRAEL IS A LEADER IN NATIONAL-LEVEL NANOTECHNOLOGY INVESTMENTS, AS A FRACTION OF GROSS DOMESTIC PRODUCT (GDP).

Country	Govt. Nano-funding (2001)	GDP (2000)	Ratio (ppm)
Japan	$550 M	$3.2 B	169
Israel	$10 M	$0.1 B	91
USA	$696 M	$9.9 B	70
W. Europe	$225 M	$7.0B	32

Source: NC Report

Note: *While the last issue of The FORUM mentioned major present and planned nanotechnology centers at the Weizmann Institute, Technion, Hebrew University and Tel Aviv University, it inadvertently omitted those at Ben-Gurion University (Ilse Katz Center, 1999) and Bar-Ilan University (Center for Advanced Materials).*