

## ElectronicsForYou

### MINIATURISATION

# NANOTECHNOLOGY HOPE OR HYPE?

**Nanotechnology is beginning to go bonkers, to the point that the 'nano' tag is acquiring a revolutionary charm like '.com.' Still for most part, it has remained elusive—a technology of the future with little to show today, except for some misplaced fears about it**

■ DIPTI AGARWAL

**I**t began in 1990s with 'holo-' and 'cyber-' followed by the '.com' era. The latest trend in corporate nomenclature is attaching the prefix 'nano-' to associate the firm with the aura of fashion and money surrounding the exciting field of nanotechnology—even if the business barely touches the nano world.

#### Defining nanotechnology

Nanotechnology exploits phenomena and structures that can occur only at the nanometre scale, i.e., in the length scale of 1 to 100 nm (scale of single atoms and small molecules), in order

to understand, create and use materials, devices and systems with fundamentally different properties and functions. The objective of this technology is to get essentially every atom in the right place to make structures consistent with the laws of physics that can be specified in molecular details and have manufacturing costs not greatly exceeding the cost of the required raw materials and energy.

It's difficult to achieve these objectives simultaneously without using some form of positional assembly (to get the right molecular parts in the right places) and massive parallelism (to keep the costs down).

Positional assembly provides tremendous advantages and is frequently used in normal macroscopic manufacturing today. The same concept is required to be applied at the molecular scale: making parts go where we want by putting them where we want. While earlier proposals achieved massive parallelism through self-replication, convergent assembly will be used for future molecular manufacturing systems.

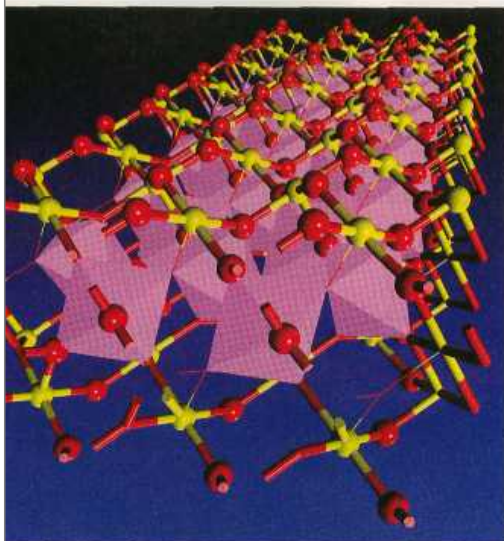
"The main excitement in nanotechnology field is due to the ability to

understand and probe the length scale which is purely nature's domain and then mimic it. The technology of the day is revolutionised in first 50 years, then expanded in next 50 years and finally transformed for the industry and regular use. Thus the basic advancements in science and technology come about twice a century and lead to massive wealth creation," said Dr Rudra Pratap, professor from Indian Institute of Science (IISc), Bangalore, and chairman of Cranes Software International, at the *Demystifying Nanotechnology* seminar held at IISc, Bangalore, on December 3, 2005.

#### Using nanotechnology

Nanotechnology includes many techniques to create structures at a size scale below 100 nm including those used for fabrication of nanowires, semiconductor fabrication (such as deep-ultraviolet lithography, electron beam lithography, focused-ion beam machining, atomic layer deposition and molecular vapour deposition) and molecular self-assembly (such as those employing diblock copolymers).

According to Dr Rajah Vijay Kumar, director and chief scientific officer at the Centre for Advanced Research and Development (CARD), Bangalore, "Nanotechnology-based Nanoblaster is a new way of thinking into tissue destruction, not only in cancer but other unwanted biological microstructures. As an offshoot of Cytotron technology developed by CARD, our researchers have developed a new technique to blast cancer



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(L to R) Paramjyothi Chowli, COO of Yashnanotech, Hilaal Alam, executive director and chairman of Qtech Nanosystems, Dr Rudra Pratap, professor at IISc and chairman of CranesSci MEMS Lab, and Dr Rajah Vijay Kumar, director and chief scientific officer at the Centre for Advanced Research and Development, Bangalore, highlighting the opportunities and threats that nanotechnology could spell for India at the seminar on Demystifying Nanotechnology held at IISc, Bangalore

cells in the human brain and other parts of the human body that has a promising future."

However, all these techniques preceded the nanotech era and are extensions in the development of scientific advancements. The challenge before nano electronics is not making switches, wires or circuits but interfacing of the micro-scale world to the nano-scale world.

India is far behind the West, and even countries like China and Singapore, with respect to the educational facilities and investment in R&D for nanotechnology.

### Current status

In India, around 20 institutions and only five companies are active in nanotechnology. There have been five government initiatives and around 200 people are engaged in research. Most of the work is being done in micro-electronics. This includes participation of the industry (SCL, SITAR, BEL and GATECH), design houses (TIL, Cypress, Analog and Intel), R&D labs (CEERI, SPL, C-MET and CSIO) and academia (IISc, IITs and DU).

The Indian nanotech industry is grappling with many problems like sub-optimal funding, lack of bold initiatives and meaningful dialogue to synergise the industry and academia, slow strategic decisions, and indifference of private enterprises. Research, which is high-risk and long-term in

nature and deals with strange ideas, needs public funding and returns are not certain on investments.

Being the second largest fruits and vegetables producer and the No. 1 tea producer, and having the fourth largest pharmaceuticals industry, India has huge potential for nanotechnology. Nanotechnology has potential applications in the fields of sensors and nanoelectronics. Auto ancillary parts are among the fastest growing applications of nanotechnology.

### Need of the hour

The old mindset of academia looking at the industry as a cashcow and the industry looking at the academic research as vanity needs to be changed. We should capitalise on the unprecedented opportunity brought by nanotechnology through vigorous participation of the industry and academia. The government should wake up and partner with the industry to set up the infrastructure needed for commercialisation of products based on nanotechnology.

According to Business Communications Company, an industry research firm, the \$7.6-billion nanotechnology industry rivals the biotechnology market and is growing twice as fast. This makes nanotech a club that many are eager to join whether they've been invited or not! ●

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