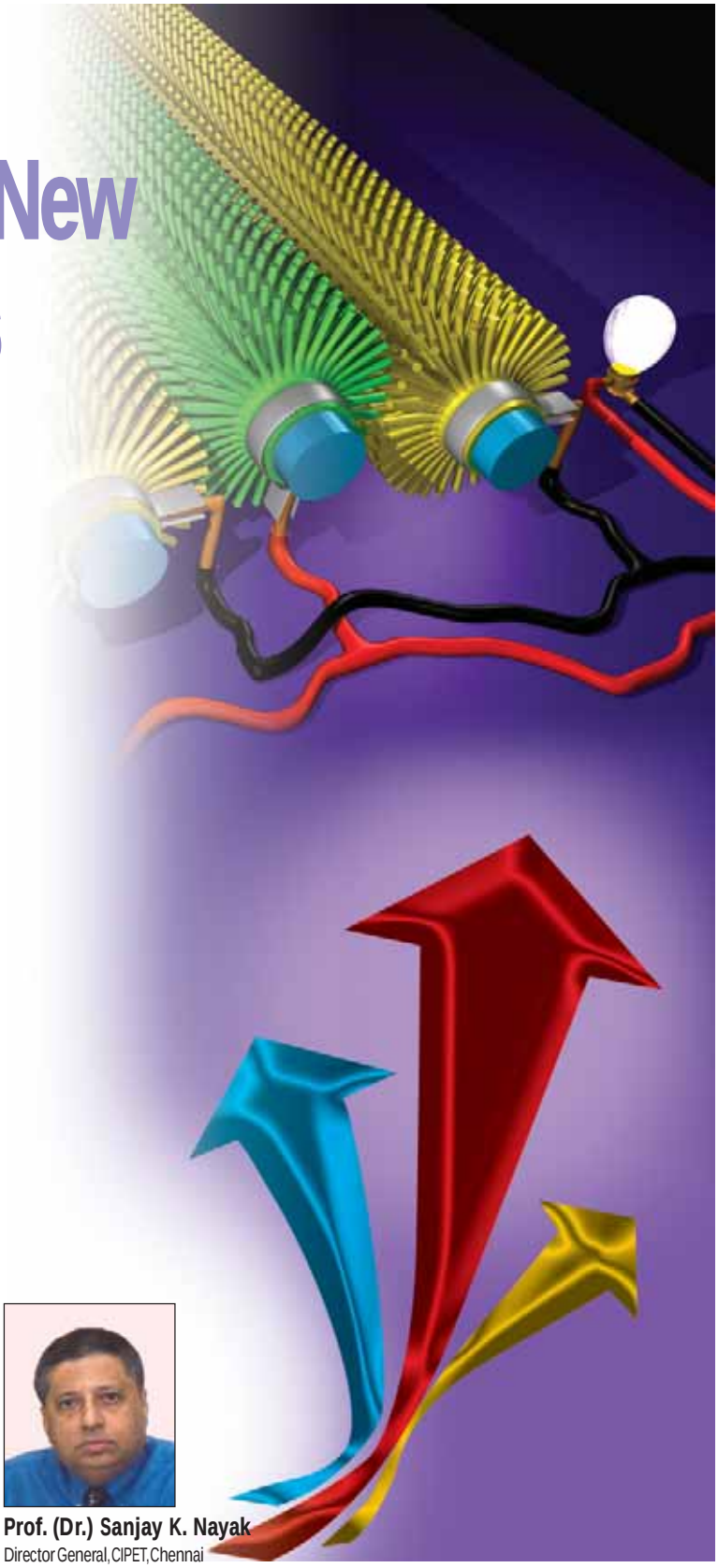
Plastics and Nano technology

High Growth, New Opportunities



The advancements in science and the experience of early adopters mean nanotechnology is easier to integrate into conventional plastics manufacturing processes.

Nanotechnology, sometimes shortened to "Nanotech", refers to a field whose theme is the control of matter on an atomic and molecular scale. Nanotechnology involves being able to understand and to control matter at the amazingly small dimensions of one to 100 nanometers, with one nanometer being equivalent to one-billionth of a meter.

At this very tiny level, the chemical, physical and biological properties of materials are different than when in their bulk form.

How new is the Small Wonder?

'There's Plenty of Room at the Bottom', in 1959, physicist and Nobel Prize winner Richard Feynman stated in a lecture to the American Physical Society. In 1986, K. Eric Drexler wrote 'Engines of Creation' and introduced the term nanotechnology.

The predictions for nanotechnology are fantastic. By the development of high-definition microscopes and other instruments that operate at a nano scale, Richard Feynman's

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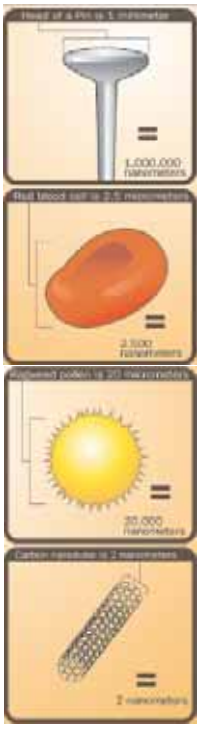
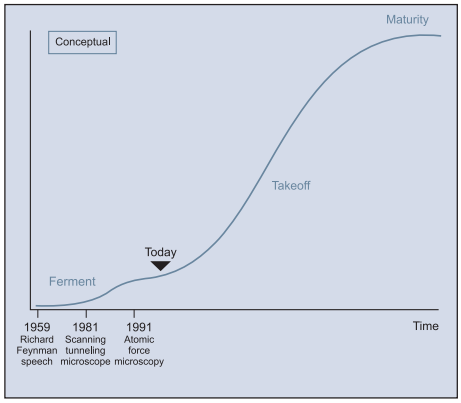
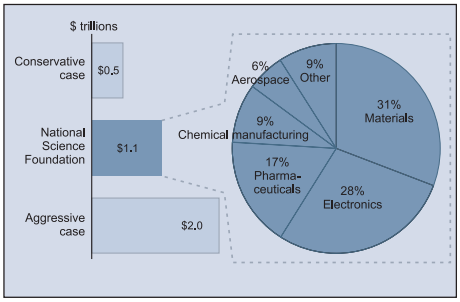


Courtesy: Berkeley Lab



Courtesy: Nanotechnology Sector Report, Center for economic growth and the Lally School of Management, 2004

1961 vision of nanotechnology's evolution has progressed in part. But in reality, we still have a long way to travel before we reach its full potential.



Courtesy: National Science Foundation and In Realis

Estimates suggest that industrial markets for nanotech such as aerospace and defense, automotive, construction and energy will develop over a somewhat longer period.

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The role of nano in chemistry related applications has been growing through years. It has also proved to be an exciting technological advancement that has the potential to contribute significantly to the future of plastic. Nanocomposites enhance the properties of thermoplastic resins, making them tougher, more heat and scratch-resistant and can be processed using the same equipment and methods as 'traditional' resins.

Nano-Plastics

Nanoplastics are plastics that have nanoscale additives to give the material additional properties. These properties vary depending on the application, but nanoscale additives can make plastics lighter yet stronger, more heat-resistant, more UV-resistant, antimicrobial, more conductive, or add any number of other properties.

The plastics industry hopes to achieve several amazing new accomplishments through the use of nanotechnology. For example, auto body paints that are completely scratch-resistant, memory chip of the size of a postage stamp, yet capable of holding the data equivalent to 25 DVD's. The advancements in science and the experience of early adopters mean nanotechnology is easier to integrate into conventional plastics manufacturing processes.

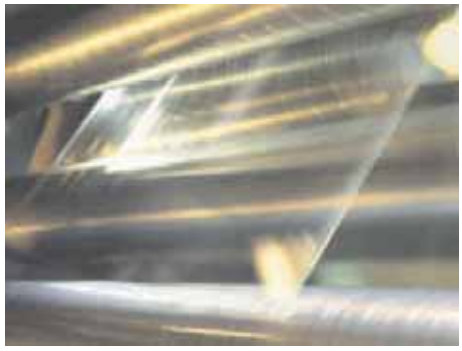
Smaller Additives, Bigger Results!

Nanoscale reinforcing materials (Nanocomposites. Nanoclays or nanocarbon fillers, including layered silicate nanoclays, nanotalcs, carbon nanotubes and graphite platelets) are used in thermoplastics, such as polypropylene, thermoplastic olefins, polyethylene terephthalate, polyethylene, polystyrene and nylon, as they are capable of resisting heat, are flame retardant, provide dimensional stability and are capable of conducting electricity. Many products currently in use can be reduced further in size while improving efficiency through nanotechnology.

Twice as Tight

Nanocomposite concentrates are being evaluated in films for enhancing barrier properties and controlling the release of additives such as biocides and dyes. Nanoclays in nylons are used as barrier layers in multi-layer PET bottles and films for food packaging.

Researchers at Bayer Polymers are now making plastic packaging even more airtight using new nanoparticle technology without compromising the primary purpose of food packaging films to protect their contents from moisture, drying out and oxygen. The miniature barriers prevent the infiltration of liquids and gases, meaning that meat and cheese stay fresh longer.

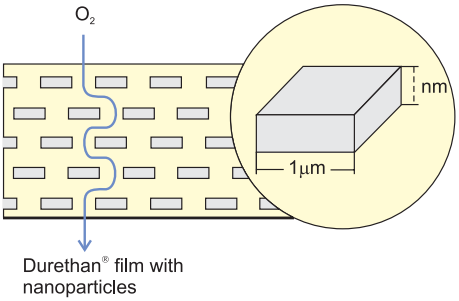


After extrusion, the paper-thin plastic films are fed over deflection rollers before finally being wound.

Silicate nanoparticles keep food fresh. The silicate platelets (incorporated in Polyamide 6), not only make the new plastic (Durethan® KU 2-2601) more impervious to gases, but also enhance its gloss. 'The minute particles influence crystallization of the plastic, acting as nuclei for crystallization of the polymer and thus improving the microstructure of the film. The diffusion of light, which makes a film look cloudy, is reduced as a result,' Ulrich says.

Nano Makes Plastics Electrically Conductive

Nanocomposites outperform standard fillers and reinforcements in raising heat resistance, dimensional stability, stiffness, flame retardancy and electrical conductivity. Typical



The layered silicate particles embedded in the plastic film present a barrier to oxygen. O_2 molecules first have to take a long detour around the nanoparticles before rmeaching their destination.

Courtesy: Bayer

applications include automotive parts, including body side molding, fuel-line components and interior center consoles. In electronics, polycarbonate and polyetherimide components of hard drives have been reinforced with nanotubes to give them better conductivity.

Plastic nanotubes are also being created (University of Dayton Research Institute) with nanotechnology, capable of carrying or dissipating significant electrical charge. Nanotubes of the order of 50 to 150 nm (nanometers) in diameter, that are remarkably flexible and have the current carrying capacity of copper, are dispersed into a supporting polymer matrix. Electrically conductive polymer nanocomposite materials offer substantial weight savings, flexibility, durability, low-temperature processability and tailored reproducible conductivity compared to conductive metal-filled systems. This technology is expected to be able to lead to the creation of conductive paints, caulks, coatings, sealants, fibers, and adhesives, potentially valuable to the automotive, aerospace, and chemical industries. *(Courtesy: Omnexus)*

More from Nano

- Special nanocomposite foams have already been created that are likely to replace solid plastic over time because they are much lighter, yet look the same as solid plastics. Potential uses for these foam nanocomposites include coffee cups, fast food containers, home insulation, carpet padding, disposable diapers, seat cushions and packaging material.
- Better ways to deliver drugs to tumors and other targets in the body may come from merging nanotechnology with our body's natural defenses along with plastics, a good choice for a drug-delivery material. Plastic capsules coated in antibodies engineered for specific targets could one day in near future, enter a person's bloodstream and adhere to the targets.

Conclusion

Nanoplastics are still an infant industry, with many exciting theoretical products on the horizon including intelligent and self-repairing plastics. Nanoscale additive technology for plastics is starting to live up to its early promise with high growth and new applications in a wide variety of sectors.

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