Nanotechnology Breakthroughs or Conversation Pieces?

This is a subject that is perennially mysterious, because it is hard to get your arms around. It is about atomic-sized particles able or targeted to do things that were never done before. It has been around for many years, yet seems to have made little impact in our lives. Or the impact has been too small to notice or too inconsequential. But are we perhaps at the threshold of important new developments that could make a big difference? Here are some recent news as reported in *Chenected*, the blog of the American Institute of Chemical Engineers. The last item is from the February 22nd edition of the Wall Street Journal.

- BASF, which has been investing in building chemicals, has been developing a technique to allow faster production of concrete building components with lower carbon emissions. Nanosized particles of calcium silicate hydrate allow concrete to harden quickly at ambient temperatures, rather than using steam to speed the hardening process.

- Cosmetic creams are intended to penetrate and renovate the skin. New findings allow creams containing nanoscale compounds to adjust a patient's DNA to treat skin-related disorders by turning off specific disease-causing genes. Skin cancers are one of the targets of nucleic acid particles 1000 times smaller than the diameter of a human hair.

- Carbon nanotubes, the blackest material known, can perfectly cloak objects in the dark of night by neither reflecting or scattering light. Use in stealth aircraft and other was machinery are an obvious application.

- A new coating that repels most liquids (100 different ones tested) has been developed from polymethylsiloxane nanoscale cubes. The coating clings to the pore structure of the material being protected, creating a fine web and leaving pockets of air which account for 95-99 percent of the coating.

- The lightest material know has been developed by German researchers using zinc oxide and graphite, based nanostructures. 75 times lighter than Styrofoam, it could, for example, be used in the electrodes of lithium ion batteries, significantly reducing battery weight. An almost limit less number of applications can be visualized.

- Early detection of cancer is an all-important goal. Early stage clinical trials are beginning on infrared-emitting coated nanoparticles that could seek and target melanoma tumors, including where they might have spread. Tests in animals have revealed no toxicity.

- Again on the health front, nano particles can absorb the toxins associated with a variety of bacteria, including some that resist antibiotics(!) Hard to visualize, but researchers "wrapped a red blood cell membrane around a biocompatible polymeric nano particle" according to an article in *Technology Review,* the MIT magazine. One red blood cell can create 3000 of the nanoparticles, each 85 nanometers in diameter.
- Tiny sensors called nanobots can be injected into the bloodstream which can transmit information to a smartphone. This allegedly allows tracking changes in blood chemistry, the early detection of cancer from the DNA of a tumor and the precursor signals of a heart attack!

This is highly complicated stuff for industrial chemical engineers like myself. But that does not mean that we shouldn't try to understand current research that has the potential of changing our world.

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