

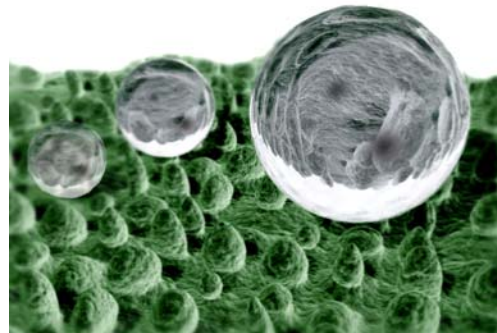
Nanotechnology that mimics nature, an intelligent approach

By Rachid Lamzah, MBA ; Victor Group Inc.

Everybody agrees nature is intelligent; one should even say “eco intelligent”. By reproducing natural mechanism, nanotechnology allows for “eco intelligent protection”.

Have you ever heard of the “*lotus effect*” (or bionic affect)?

Botanists who have studied lotus leaves have found that they have a natural cleaning mechanism. This cleaning mechanism was discovered in 1997 by Professor Wilhelm Barthlott, the director of the Nees-Institut for Biodiversity in Bonn, Germany. The lotus effect in material science is the observed self-cleaning property found with lotus plants. Their microscopic structure and surface chemistry mean that the leaves never get wet. Rather, water droplets roll off the leaf surface like mercury, taking mud, tiny insects, and contaminants with them. This is known as superhydrophobicity, or more commonly, the lotus effect.



Whether in upholstery, in office furniture, in healthcare or in apparel, fabrics often need protection against stain and water. This protection has, so far, been provided using fluorochemical-based finishes.

The US fluorochemicals industry is large, around \$3.5 billion per year; it includes fluorocarbons, fluoropolymers, specialty organics, inorganic fluorine gases, and inorganic fluorochemicals, used primarily as refrigerants, coatings, fluoropolymer precursors, blowing agents, solvents and cleaners. However, fluorochemicals have been proven to be toxic to animals and human beings and are highly persistent in our environment. Fluorochemicals represent an emerging issue of environmental concern due to their global distribution, persistence and bioaccumulation.

In its elementally isolated (pure) form, fluorine is a poisonous, pale, yellowish brown gas, with chemical formula F_2 . Like other halogens, molecular fluorine is highly dangerous; it causes severe chemical burns on contact with skin.

For some history, the first large-scale production of fluorine was needed for the atomic bomb Manhattan project in World War II.

After that came Chlorofluorocarbons, extensively used in air conditioning, refrigeration and as a blowing agent (aerosols). Chlorofluorocarbons have been banned for these applications because they contribute to ozone destruction and the ozone hole.

Today, fluorochemicals, in all their forms are widely used in many industrial applications, however, the scientific community as well as governmental authorities has been highlighting and encouraging the need to reduce the use of such chemicals. The need to find alternatives that respect the environment and the quality of life on earth is urgent! Progress has been made in several industries but the textile industry remains among the biggest challenges! This is where nanotechnology comes to the rescue!

By using microscopic surface roughness, surface dynamics and non-carbon based nanoparticles, GreenShield™ finish on eco INTELLIGENT® polyester fabrics guarantees a superior stain resistance and water repellency while using 5 times less fluorochemicals. These eco-friendly properties are improved by the fact that GreenShield™ is predominantly a water-based formulation with less than 1% organic solvent (compared with 7% to 10% for typical fluorochemical finishes).

GreenShield™ and eco INTELLIGENT® polyester fabrics take advantage of nanotechnology advanced applications. Nanotechnology involves the controlled manipulation of particles smaller than the wavelength of light. At this scale, quantum physics starts to apply, making possible some astonishing results and applications. One of the key factors behind the rapid development in the field of chemical nanotechnology for textile is the further development of the Sol-Gel method; a controlled growth and aggregation process of molecular units. This process permits a highly targeted and

reproducible representation of multi-functional nano-particulate systems. The resulting range of materials ranges from vitreous-hard to Polymer-soft with variable surface properties varying from hydrophilic (anti-misting effect) to completely water and stain repellent (lotus or bionic effect), which is exactly the effect reproduced by the GreenShield finish on eco INTELLIGENT® polyester fabrics.

But, what exactly is nanotechnology?

When *K. Eric Drexler* popularized the word 'nanotechnology' in the 1980's, he was talking about building machines -motors, robot arms, and even whole computers- on the scale of molecules, a few nanometers wide, far smaller than a cell! Drexler spent the next ten years describing and analyzing these incredible devices, and responding to accusations of science fiction. As nanotechnology became an accepted concept, the meaning of the word shifted to encompass the simpler kinds of nanometer-scale technology.

Nanotechnology is hailed by the US government and industry organizations as "The Next Industrial Revolution." It is a new category of technology that involves the precise manipulation of materials at the molecular level or a scale of roughly 1 to 100 nanometers, with a nanometer equaling one-billionth of a meter. How small exactly is a nanometer? As one journalist had put it, "If a nanometer were somehow magnified to appear as long as the nose on your face, then a red blood cell would appear the size of the Empire State Building, a human hair would be about two or three miles wide, one of your fingers would span the continental United States, and a normal person would be about as tall as six or seven planet Earths piled atop one another."

Much of the work being done today that carries the name 'nanotechnology' is not nanotechnology in the original meaning of the word. Nanotechnology, in its traditional sense, means building things from the bottom up, with atomic precision. This theoretical capability was envisioned as early as 1959 by the renowned physicist Richard Feynman.

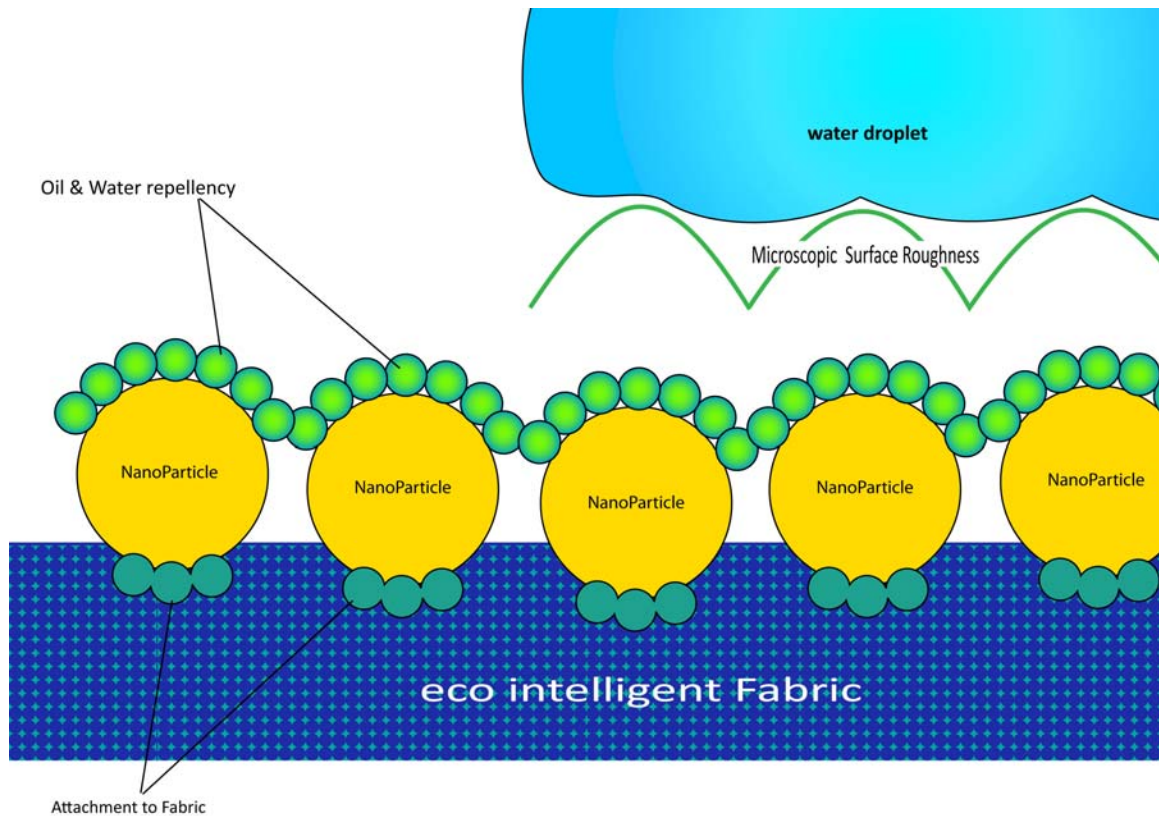
“I want to build a billion tiny factories, models of each other, which are manufacturing simultaneously. . . The principles of physics, as far as I can see, do not speak against the possibility of manoeuvring things atom by atom. It is not an attempt to violate any laws; it is something, in principle, that can be done; but in practice, it has not been done because we are too big.” — Richard Feynman, Nobel Prize winner in physics

Based on Feynman's vision of miniature factories using nanomachines to build complex products, advanced nanotechnology (sometimes referred to as molecular manufacturing) allows for positionally-controlled mechanochemistry guided by molecular machine systems.

Nanotechnology is sometimes referred to as a *general-purpose technology*. That's because in its advanced form it will have significant impact on almost all industries and all areas of society. It will offer better built, longer lasting, cleaner, safer, and smarter products for the home, for communications, for medicine, for transportation, for agriculture, and for industry in general. We can foresee some of these advances already!

So far, many of the applications for nanotechnology have been oriented toward modifying surface properties; modifier surface coatings have already been put to good use to provide a competitive advantage in sport competition, like in 2002 winter Olympics in Salt Lake City, when a nanotechnology ski wax was used for the first time to reduce surface frictions and gain speed.

GreenShield™ nanostructured surface of eco INTELLIGENT® fabrics mimics the lotus leaf's natural structure. As discussed above, the lotus leaf surface presents roughness on two scales that prevent the droplet from getting in contact with the actual surface, and make it roll off. Contrarily to conventional stain and water repellents, GreenShield™ makes droplets roll off the surface and not slide on it; by this mean, droplets tend to collect any dirt particle providing fabric with an auto-cleaning action.



GreenShield™ Acting mechanism

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