TiO2-Titanium Dioxide

History of TiO2

The element Titanium was discovered in 1791 by William Gregor, in England. Gregor spent much of his time studying mineralogy , which led him to his discovery. This happened when he discovered a sample of a black sandy substance in his neighborhood. He studied this substance and after he was assured that it was a mineral, he called it menachanite. Four years later a man named Martin H. Klaproth, recognized that there was a new chemical element in this mineral, he later named it Titanium after the Titans, which were humongous monsters that ruled the world in Greek mythology. Martin H. Klaproth was not able to make the pure element of titanium however, he was only able to produce TiO_2, or Titanium Dioxide.

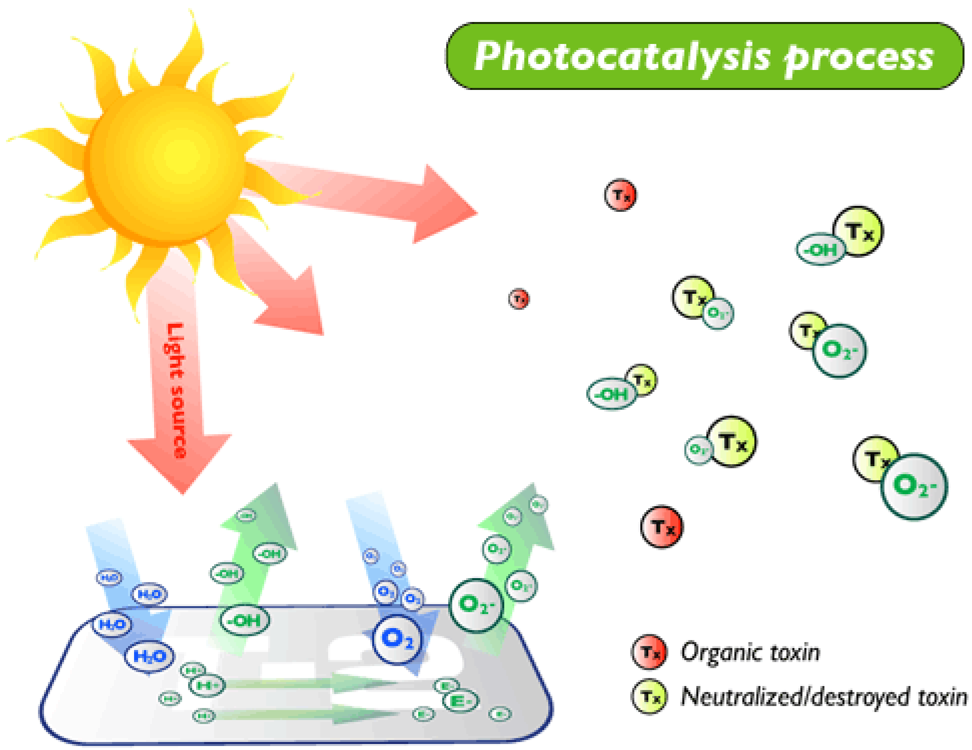
Titanium dioxide (TiO_2) is a multifaceted compound. It's the stuff that makes toothpaste white and paint opaque. TiO_2 is also a potent photocatalyst that can break down almost any organic compound when exposed to sunlight, and a number of companies are seeking to capitalize on TiO_2's reactivity by developing a wide range of environmentally beneficial products, including self-cleaning fabrics, auto body finishes, and ceramic tiles. Also in development is a paving stone that uses the catalytic properties of TiO_2 to remove nitrogen oxide from the air, breaking it down into more environmentally benign substances that can then be washed away by rainfall. Other experiments with TiO_2 involve removing the ripening hormone ethylene from areas where perishable fruits, vegetables, and cut flowers are stored; stripping organic pollutants such as trichloroethylene and methyl-tert-butyl ether from water; and degrading toxins produced by blue-green algae. It remains to be seen, however, whether the formation of undesirable intermediate products during these processes outweighs the benefits offered by TiO_2's photocatalytic properties.

Titanium dioxide is a well-known photocatalyst for water and air treatment as well as for catalytic production of gases. The general scheme for the photocatalytic destruction of organics begins with its excitation by suprabandgap photons, and continues through redox reactions where OH radicals, formed on the photocatalyst surface, play a major role.

Titanium dioxide is non-toxic and therefore is used in cosmetic products (sunscreens, lipsticks, body powder, soap, pearl essence pigments, tooth pastes) and also in special pharmaceutics. Titanium dioxide is even used in food stuffs, for instance in the wrapping of salami. Small amounts added to cigar tobacco are the cause of the white ash cigar smokers so cherish.

Photocatalyst:

A substance that helps bring about a light-catalyzed reaction, such as chlorophyll in photosynthesis. Like photosynthesis, the reaction continues throughout the day once begun.



Using energy from light, T-2 creates two oxidation reactants: hydroxyl radicals and superoxide anion. These reactants decompose toxic organic substances through oxidation.

Nanotechnology

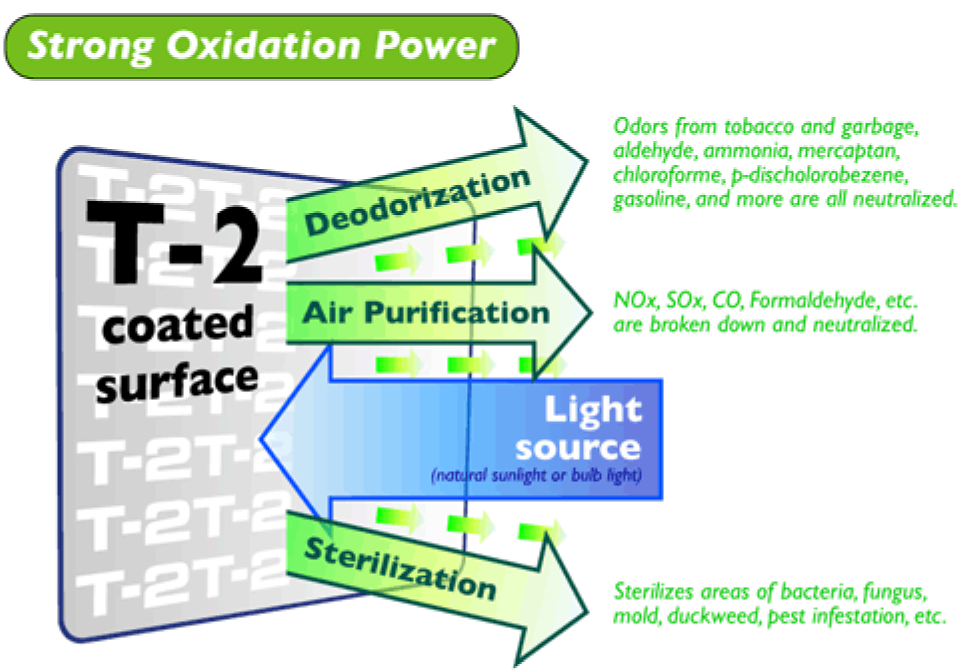
Nanotechnology is not just about the size of very small things, it is the revolutionary science and art of manipulating matter at the atomic or molecular scale. More important, it is about the structure and the ability of molecular compounds to "work". Research in areas related to nanomaterial is needed to develop manufacturing techniques. In particular, it is a synergy of top-down with bottom-up processes.

When matter is as small as 1 to 100 nanometers, many of its features will easily change and have many unique features both different from macro-matters and single atoms due to the quanta effect, regional confinement of matter, and huge surface or interface effects. The final objective of nanometer technology is to produce products of special functions with new physical and chemical features by making atoms, molecules and matters presenting their features directly in the length of a nanometer: the strength of ten times of iron could be very light, all

information in a library could be stored in a chip the size of a sugar cube, and tumors the sizes of only several cells can be detected.

The US Business Weekly listed nanometer technology as one of the three key areas of work in the 21st century. From 1999, the US government decided to classify research in nanometer technology as one of the 11 key areas in the first ten years of the new century. In February 2000, US president Bill Clinton announced that the US Federal Government would invest 495 million dollars to set up a work group and put forth a research report promoting nanometer technology, with hopes that it will lead to the next industrial revolution.

Titanium dioxide's photocatalytic characteristics are greatly enhanced due to the advent of nanotechnology. At nano-scale, not only the surface area of titanium dioxide particle increases dramatically but also it exhibits other effects on optical properties and size quantization. An increased rate in photocatalytic reaction is observed as the redox potential increases and the size decreases. In some cases (such as with T-2's special composition) energy from any ambient light source can be used effectively as the energy source of photocatalysis instead of UV light.



Hydroxyl radicals are among the most powerful oxidizing radicals, even stronger than chlorine, ozone, and peroxide. They act as very powerful disinfecting agents by oxidizing the cells of microorganisms, causing rupture of the cell and leakage of vital composition.

T-2: New Photocatalyst Nanotechnology!

Photocatalysis refers to the chemical reaction that occurs when light strikes a chemical compound that is light sensitive, such as titanium oxide. When light strikes titanium dioxide, the base compound in T-2, a chemical reaction will be repeated in the immediate region and cause the breakdown of organic toxins, odors, and more. This reaction has many valuable results, several are listed below.

Deodorization applications.
T-2 doesn't cover up smells, like conventional air freshners, it actually attacks the root of the smell by causing the breakdown of the origin of the odor (ammonia, aldehyde gas [smoke], etc).

Water purifying applications.
T-2 causes detrimental organic matter such as organic chlorine compounds, tetrachlorethylene, trihalomethane and other harmful substances to be broken down.

Environmental improvement applications.
T-2 also actively removes environmental pollution substances, such as NOx emitted by exhaust gas etc. from the atmosphere. SOx, a detrimental organic matter present in the atmosphere, is also broken down.

Antibacterial applications.
Bacteria such as e-coli, yellow staphylococcus, mold fungi,etc. are broken down by TiO2 (the main ingredient in T-2). See our lab reports page for more detailed information on the effectiveness of T-2 versus harmful bateria.