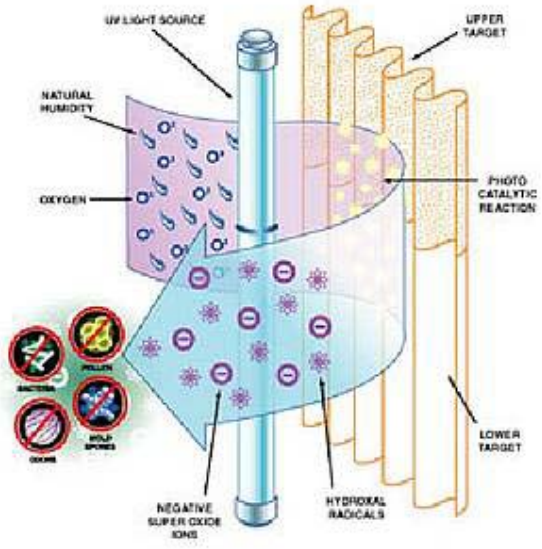
LUMASENSE TECHNOLOGIES

What is Photocatalysis?



The oxidation of most hydrocarbons proceeds rather slowly in absence of a catalytic active substance. A photocatalyst decreases the activation energy and photoinduced processes (particles with strong oxidation and reduction ability) occur. A photocatalytic system consists of semiconductor particles (photocatalysts) which are in close contact with a liquid or gaseous reaction medium. Exposing the catalyst to ultraviolet light processes like redox reactions and molecular transformations take place.

TiO2 as Photocatalyst.

Titanium dioxide (TiO2) is one of the basic materials in everyday lift. It has been widely used as white pigment in paints, cosmetics and foodstuffs. Generally, titanium dioxide is a semiconducting material which can be chemically activated by light. The photoactivity of TiO2 which have been known for approx. 60 years is investigated extensively.

In 1972, Fujishima and Honda [1] discovered the photocatalytic splittibg of water on TiO2 electrodes. This event marked the beginning of a new era in heterogeneous photocatalysis. Although TiO2 absorbes only 5% of the solar light reaching the surface of the earth, it is the best investigated semiconductor in the field of chemical conversion and storage of solar energy. In recent years semiconductor photocatalysis using TiO2 has been applied to important problems of environmental interest like detoxification of water and air.

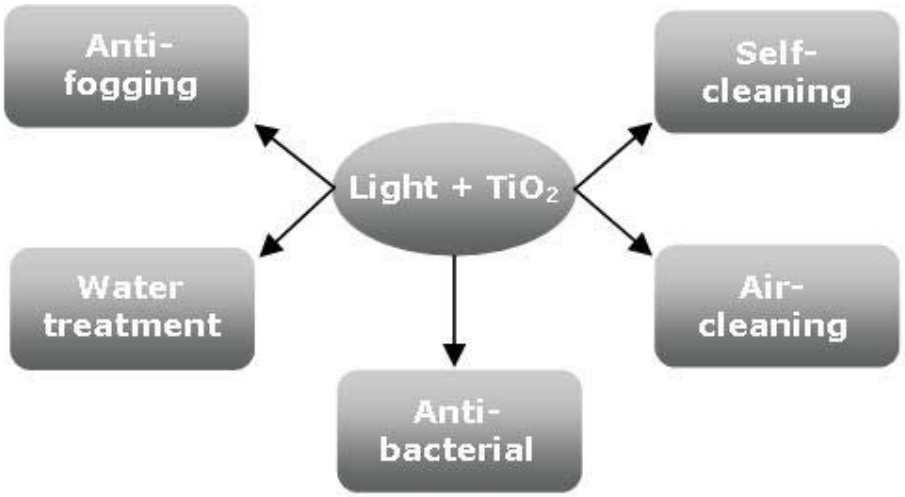


Figure 1. Major areas of activity in titanium dioxide photocatalysis

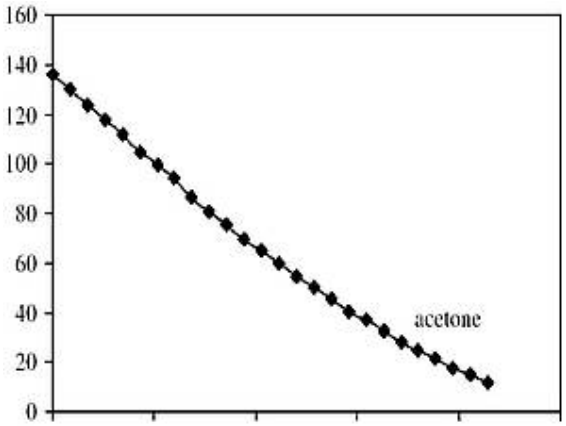
Practical applications of TiO2 photocatalysis.

In Figure 1 the main areas of activity in TiO2 photocatalysis are shown. As already menthioned, in the last 10 years photocatalysis has become more and more attractive for the industry regarding the development of technologies for purification of water and air. Compared with traditional advanced oxidation processes the technology of photocatalysis is known to have some advantages, such as ease of setup and operation at ambient temperatures, no need for postprocesses, low consumption of energy and consequently low cost.

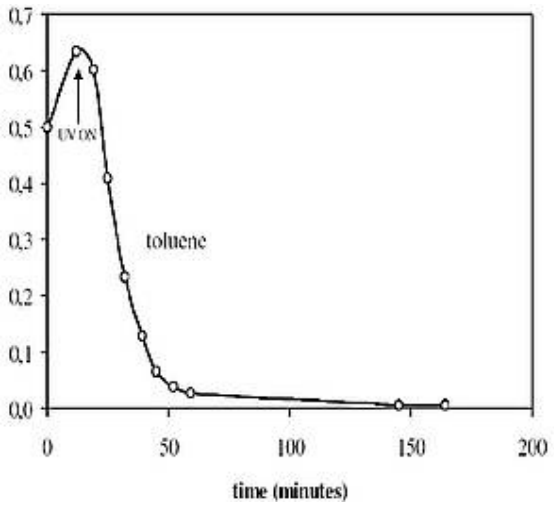
Photocatalytic oxidation has been applied for removing and decomposing pollutants in indoor air. The used reactors trap and chemically oxidize organic compounds, converting them primarily to CO2 and water. These reactors operate at room temperature and negliglible pressure. Therefore, they may be redily integrated into new and existing heating, ventilation, and air conditioning systems.

TiO2 coated ceramic tiles are considered to be very effective against organic and inorganic material, as well as against bacteria. The application of these tiles in hospitals and care facilities will reduce the spread of infections.

Removal of Indoor VOS's



In addition, many health problems are caused by biological particles such as fungi, moulds, bacteria and other micro-organisms. A typical indoor pollutant is ammonia coming from cleaning products. Above Figure shows the photocatalytic degradation time of ammonia. The degradation products are mainly N2 and H2O .



One typical VOC reference is Toluene and above Figure shows the photocatalytic degradation time of this aromatic substance. As can be seen the technology can even degrade very low concentrations of chemicals in gaseous atmosphere.