

Different **dimension** of perfection



# NANO titanium dioxide



AIR POLLUTION REDUCTION and SELF-CLEANING EFFECT by

## PHOTOCATALYSIS

 **CINKARNA**

[www.cinkarna.si](http://www.cinkarna.si)



## AIR QUALITY

Air pollution has negative impacts both on the human health and the natural environment. We still haven't done enough in this regard, which is why there are still more measures that need to be taken in order to protect our health and nature, specifically with regards to nitrogen oxides, VOC and other organic pollutants,... Nitrogen oxides contribute to the formation of smog and acid rain, as well as affecting tropospheric ozone and are linked with a number of adverse effects on the respiratory system of all living beings. Whilst outdoor air pollution is important, we also need to consider the potential health effects of poor air quality indoors, which is created by a mixture of pollutants generated from inside the building and external pollution migrating indoors.



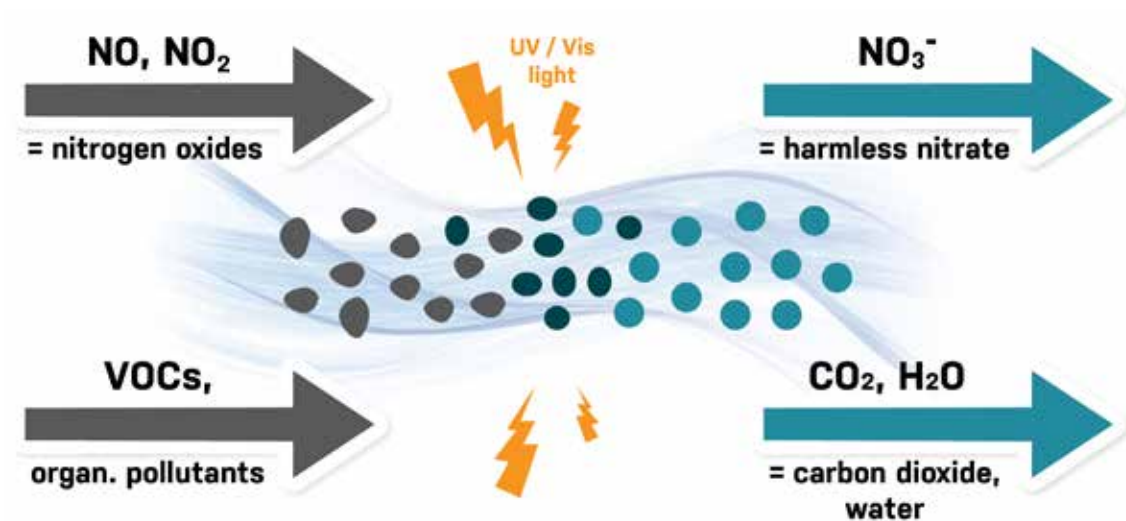
## NANO TITANIUM DIOXIDE AS PHOTOCATALYTIC MATERIAL

Titanium dioxide is one of the most widely used inorganic materials in the world. The most common form is pigmentary titanium dioxide, but in recent years there has been a growing demand for nano titanium dioxide.

Turning to smaller particles, i.e., creating nano-sized titanium dioxide particles offers new properties and advantages to final materials that they are incorporated in, for example, such as reducing pollution of the air outdoors and indoors by using a photocatalytic process to help protect our health and environment. The photocatalytic process reduces pollution - it decomposes harmful NO<sub>x</sub>, SO<sub>x</sub>, VOC and other organic pollutants from the air and water and prevents the growth of micro-organisms, while at the same time providing a self-cleaning effect.

## PHOTOCATALYSIS – HOW DOES IT WORK?

When light touches the surface, it promotes the photocatalytic action of the material to which nano TiO<sub>2</sub> particles were added. The photocatalytic reaction takes place on the particle's surface upon light absorption, thus rendering it oxidative and creating free radicals in the process. The radicals oxidize organic molecules and NO<sub>x</sub> on the surface of nano titanium dioxide into carbon dioxide, water and nitrates. Harmful nitrogen oxides and organic impurities disintegrate on the surface, while air motion, rain and evaporation help remove these substances and consequently clean the surface of the material.



## ADVANTAGES

- Advantage for humans and the environment with regards to health and care
- Self-cleaning effect
- Decomposition of harmful pollutants into harmless substances from the air and water
- Preventing the growth of algae and fungi
- Preserving the natural look of buildings and monuments
- Lower economic and social costs due to pollution
- Relatively low increase in the costs of final photocatalytic products
- It helps to comply with strict EU and national regulatory requirements with regards to the air pollution reduction

## CHARACTERISTICS OF PHOTOCATALYTIC NANO TiO<sub>2</sub>

- Particles are smaller than 100 nm
- Larger active surface means significantly more intense reactivity
- No more pigmentary properties, but transparent look
- Decomposition of pollutants with the help of photocatalysis process as a photocatalytic material
- Self-cleaning effect

## PHOTOCATALYTIC APPLICATIONS OF NANO TiO<sub>2</sub>

- Concretes, paving and asphalt surfaces for walking and driving
- Façades, roof tiles for buildings
- Indoor wall & ceiling surfaces/decorative paints
- Architecture & monument surfaces (historical statues and buildings)
- Other surfaces, such as windows, metal, ceramic tiles, textiles,...

## OUR NANO TiO<sub>2</sub> PRODUCTS FOR PHOTOCATALYTIC APPLICATIONS

PRODUCT	USE	APPLICATION
<b>CCA 100 BS</b>	Outdoor application	Self-cleaning effect, decomposition of organic pollutants, water cleaning, air cleaning, DeNOx, protection from moss and fungi
<b>CCR 200 N</b>	With improved performance in outdoor and indoor applications	Self-cleaning effect, decomposition of organic pollutants, water cleaning, air cleaning, DeNOx, protection from moss and fungi



### DID YOU KNOW?

The surface of one photocatalytic active roof covering a family house and its driveway has the ability to remove the amount of NOx created by two passenger cars in one year of average use.



## OUR SPECIFIC APPROACH TO MANUFACTURING

The elementary principle of our nano TiO<sub>2</sub> is the sulphate synthesis process, which is upgraded for the synthesis of final nano product. In Cinkarna Celje we decided to be strategically oriented towards the production of nano TiO<sub>2</sub> only in the form of a **water suspension**. We have already developed the synthesis methods for anatase and rutile nano particles that we obtain in the form of a suspension without any intermediate powder phase.

Advantages of our manufacturing process enable us to efficiently adapt to the customer's specific needs and provide them with high-quality products. The most important advantage and the difference in the manufacturing process is that we produce materials in the form of stable water suspensions.

Numerous manufacturers of nano TiO<sub>2</sub> material produce it by making a powder first and then grinding it into nano particles. In this case, they produce the powder form of nano TiO<sub>2</sub> materials, which is afterwards suspended in water. In our production, all process phases take place in an aqueous medium which guarantees better stability and dispersibility for our products without the presence of dry powdery material. In this way, we prevent the possible negative impacts that nanopowder causes if it comes into direct contact with people and the environment.



## CCA 100 BS

## CCR 200 N

Both materials are stabilized aqueous suspensions of nano titanium dioxide (TiO<sub>2</sub>) with an excellent photocatalytic activity. Our particle design technology is the basis for premium product performance in a wide range of applications.

### Designed and optimized for photocatalyst use:

- Nano TiO<sub>2</sub> without pigmentary properties.
- Highly stabilized, neutral pH, white aqueous suspension.
- Recommended for applications with a neutral or basic pH range.

- Degradation of organic and inorganic molecules under UV light.
- Anatase crystal structure.

- Degradation of organic and inorganic molecules under UV and visible light.
- Rutile crystal structure.
- Crystal lattice doped with N.

### Main applications are:

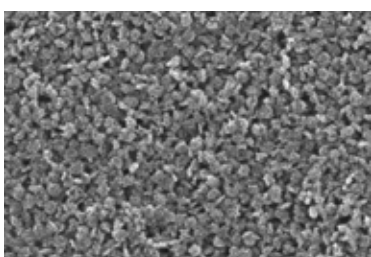
- Photocatalyst used for self-cleaning effect on various building materials, glass, ceramics, textiles, etc.
- Air and water purification (degradation of NO<sub>x</sub>, SO<sub>x</sub>, VOCs, other organic molecules, etc).
- Removing unpleasant odors.

- Outdoor applications.

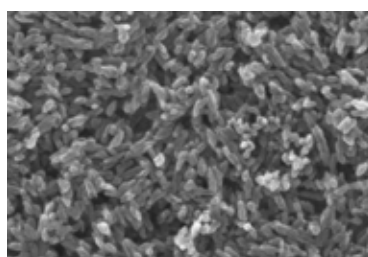
- Indoor and outdoor applications.

TiO <sub>2</sub> content	20 - 22 %	TiO <sub>2</sub> content	20 - 22 %
Density	~ 1.2 g/cm <sup>3</sup>	Density	~ 1.2 g/cm <sup>3</sup>
pH	7 - 9	pH	6 - 8
Crystallite size (Scherrer)	~ 10 nm	Crystallite size (Scherrer)	~ 30 nm
Specific Conductivity	< 1 mS/cm	Specific Conductivity	< 1 mS/cm
Specific surface area	> 250 m <sup>2</sup> /g	Specific surface area	> 60 m <sup>2</sup> /g
Typical photocatalytic activity ISO 22197-1*	<b>UV</b> 30.2 mg NO/m <sup>2</sup> h	Typical photocatalytic activity ISO 22197-1*	<b>UV</b> 22.4 mg NO/m <sup>2</sup> h <b>Vis</b> 17.2 mg NO/m <sup>2</sup> h

\* Measurements were performed by Institut für Technische Chemie (Hannover, Germany). A value more than 5.0 mg NO/m<sup>2</sup>h can be regarded as very good degradation efficiency



SEM image of the  
CCA 100 BS



SEM image of the  
CCR 200 N

## Applications with our photocatalytic nano TiO<sub>2</sub> materials



Maribor, Slovenia



Celje, Slovenia



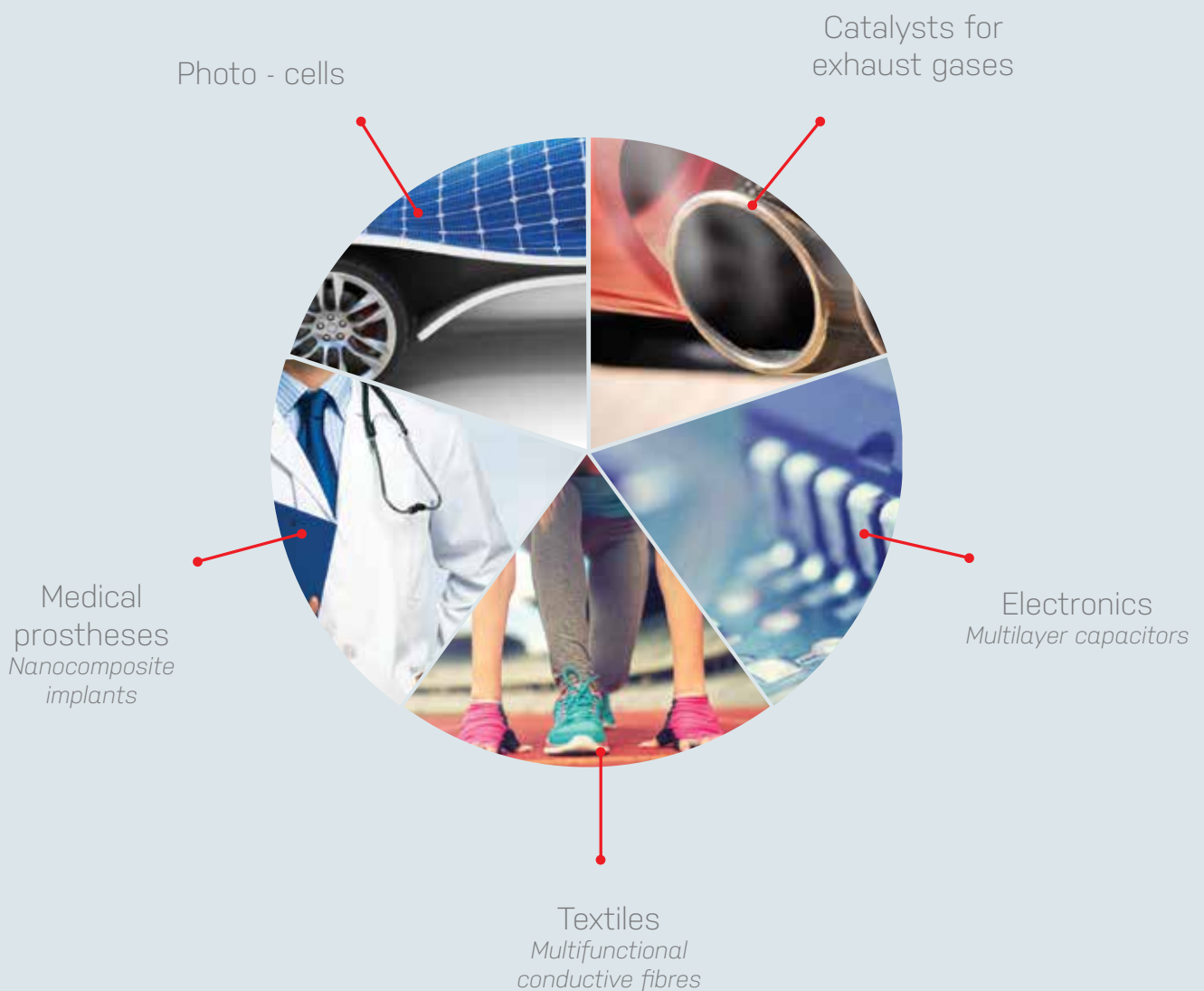
Barcelona, Spain



Maribor, Slovenia

## THE FUTURE ...

Nano  $\text{TiO}_2$  has an enormous potential for the future and represents a great advantage for people and the environment. Its scope of application extends into the fields of medicine, textile industry, energetics, automotive industry, electronics, etc.





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