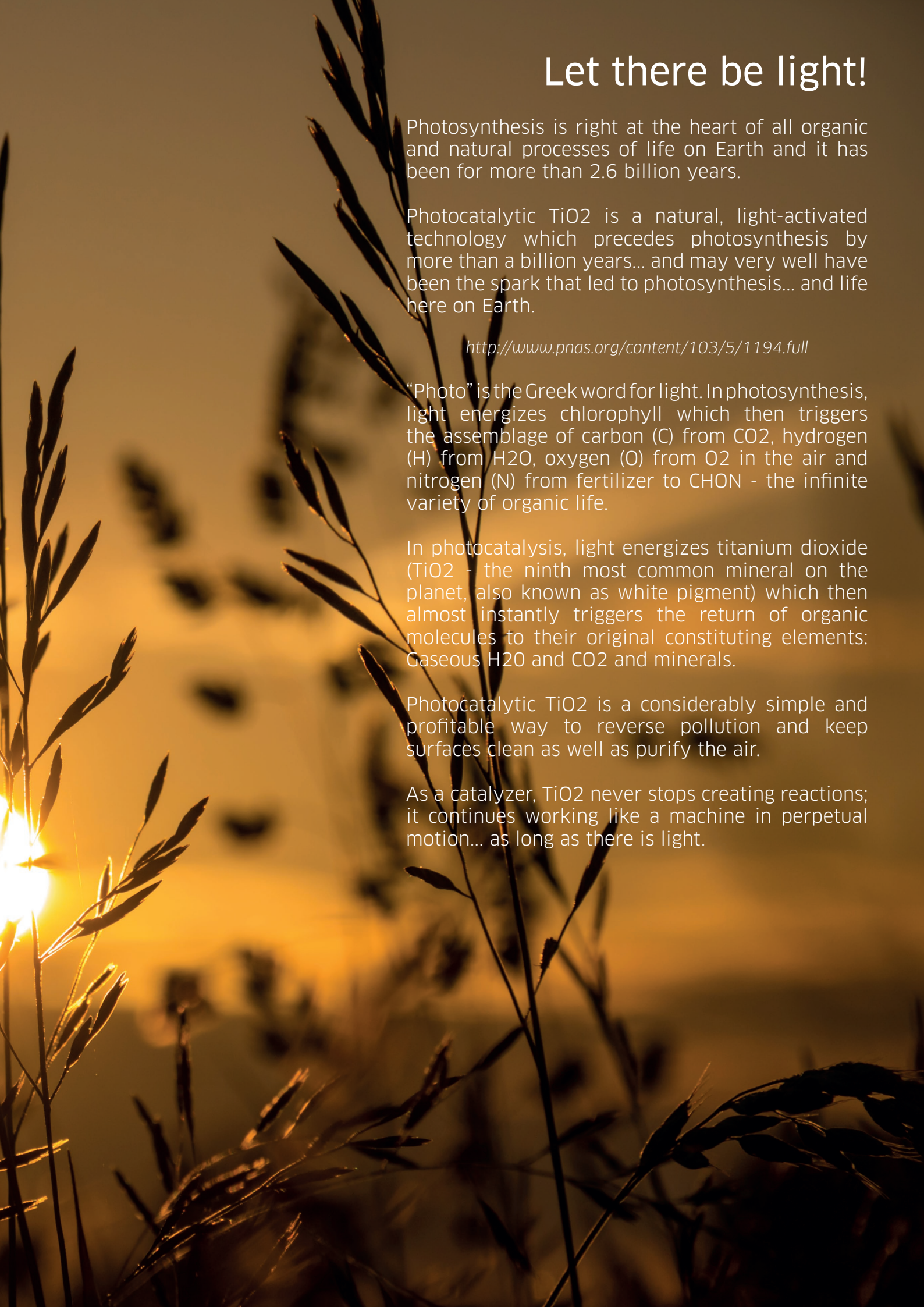
pureti™

The History of Oxidizing Photocatalysis



Let there be light!

Photosynthesis is right at the heart of all organic and natural processes of life on Earth and it has been for more than 2.6 billion years.

Photocatalytic TiO2 is a natural, light-activated technology which precedes photosynthesis by more than a billion years... and may very well have been the spark that led to photosynthesis... and life here on Earth.

http://www.pnas.org/content/103/5/1194.full

"Photo" is the Greek word for light. In photosynthesis, light energizes chlorophyll which then triggers the assemblage of carbon (C) from CO2, hydrogen (H) from H2O, oxygen (O) from O2 in the air and nitrogen (N) from fertilizer to CHON - the infinite variety of organic life.

In photocatalysis, light energizes titanium dioxide (TiO2 - the ninth most common mineral on the planet, also known as white pigment) which then almost instantly triggers the return of organic molecules to their original constituting elements: Gaseous H20 and CO2 and minerals.

Photocatalytic TiO2 is a considerably simple and profitable way to reverse pollution and keep surfaces clean as well as purify the air.

As a catalyzer, TiO2 never stops creating reactions; it continues working like a machine in perpetual motion... as long as there is light.

General description and credentials

PURETi is the American manufacturer of the safest, most solid, versatile and proven photocatalytic solutions on the international market today. The link below leads to a video produced by our newest client, Neolith, a Spanish tiling manufacturer, which offers a good introduction.

https://www.youtube.com/watch?v=NxfUDGTd0nc&feature=youtu.be

PURETi Group produces (in America and Spain) and sells (all over the world) water and mineral solutions that are applied with a spray to the inside and outside of buildings and surfaces of all kinds ...and construction products such as solar panels, facade tiles, lamps and air purifier... to transform surfaces treated with light-activated self-cleaning air purifiers.

Current applications include solar panels that remain cleaner over longer periods of time to produce more electricity; offices and schools with better Indoor Air Quality (IAQ) to prevent respiratory problems; buildings and vehicles that require less maintenance; streets that reverse outdoor pollution; wind turbines that remain clean; LED lighting accessories that save energy and purify the air; and greenhouses and indoor farms that produce extraordinary results.

PURETi did not discover this amazing technology...

That credit goes to a couple of Japanese scientists (Professors Honda and Fujishima from the University of Tokyo) who, in 1968, were the first to determine what happens when light gives energy to titanium dioxide (TiO2), the mineral also known as “white pigment”.

PURETi was not the first to market this self-cleaning, light-activated air purification technology. That credit goes to the TOTO Corporation which, in 1998, was the first to market self-cleaning photocatalytic ceramic tiling. The problem they had was that it was a first-generation product (see the pyramid of the evolution of photocatalytic technology further below). Just like electric cars were not competitive enough 40 years ago, TOTO technology required technological progress.

PURETi has the safest, strongest, most versatile and most profitable version of TiO2 photocatalytic technology on the market today with credentials like:

1- NASA choosing PURETi and only PURETi as a “dual-use technology partner” in 2012 after an exhaustive review of all known competitors.

https://spinoff.nasa.gov/Spinoff2012/ee_5.html

2- The European Joint Research Centre, JRC, chose PURETi -and only PURETi - as its photocatalytic partner for the iSCAPE Project aimed at smart pollution control. This was an EU Horizon 2020 project.

https://horizon-magazine.eu/article/10-breakthroughs-shape-europe-next-60-years_en.html
https://www.iscapeproject.eu/about/consortium/

3- Cristal Global (which will soon become Tronox Cristal, the largest producer of TiO2 in the world) chose PURETi, and only PURETi, as its exclusive partner in the aqueous photocatalytic environment.

http://www.cristal.com/news-room/news/Pages/Cristal%20and%20PURETi%20Partnership%20Press%20Release.aspx

4- Iowa State University professor Jacek Koziel discovered that PURETi is 10 to 25 times more photocatalytically effective than Degussa / Evonik P25, the so-called “golden standard” of photocatalytic TiO2 research.

http://www.mdpi.com/2073-4433/8/6/103

5- PURETi is the only supplier of TiO2 photocatalytic solutions that has been tested by the nano division of NIOSH, the strictest occupational risk prevention authority in the world... and it found that it was totally safe and would not cause any type of nanoparticles when applied.

http://pureti.com/content/documents/2011-NIOSH-paper-on-TiO2-Nano-Safety-1.pdf

6- PURETi was chosen by Apple, Amazon, Aunde, Aramark, the City of Austin TX, the Atlanta Public School District and the list goes on and on with new additions every day.

nanoair
SOLUTIONS

PURETi - Company history

The key to the efficacy of a photocatalytic product is the resistance of the catalyzer and the quantity of surface area exposed to the active ingredient - anatase TiO2 nano particles.

The greater the exposed surface area, the greater the interaction between the catalyzer and the light, air, moisture and pollutants. The strongest catalyzers with the largest exposed surface area produce the best results.:

1. **Generation 1** - Embedded powders - i.e. Toto, Pilkington Glass, Italcementi Cement, Alcoa Coating - these products are produced by incrusting, sintering, mixing or coating anatase TiO2 powder or nanoparticles in the body of a product or construction material. Their photocatalytic efficacy is limited by the agglomeration of particles and the reduction in exposed surface area. The yield when applied to solid elements is limited by the requirement of having to re-pave or re-treat the surface with a thin layer, thereby continuously requiring double the product.

2. **Generation 2** - Coatings or paintings – examples: Airlite, Cristal, Gens Nano, Global Engineering, KNOxOut, Sto - these relatively thick paints or coatings are applied at a speed of approximately 15 m2 per liter to road surfaces. Although the photocatalytic efficacy of these coatings is higher than with Generation 1 products, it continues to be less than ideal and the yield is limited due to low rates of coverage as well as variable and questionable durability.

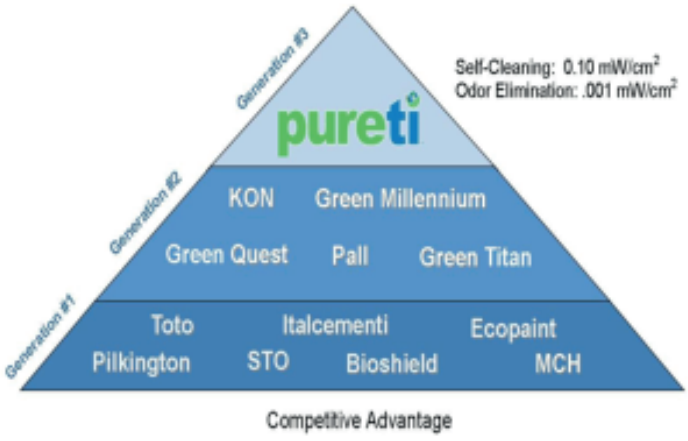
3. **Generation 3** - Aqueous surface treatments - i.e. PURETi - this unique and versatile amorphous and crystalline titanium suspension more strongly holds to roads, barriers and facades using lower quantities than needed with any other known competitor's products.

PURETi can be effectively applied to offer the highest performance rate on the market. One liter of PURETi covers 75 m2 of road or facade surface. Moreover, PURETi with CristalACTiV is the strongest catalyzer on the market - 10 to 25 times stronger than Degussa P25 (the so-called "golden master of TiO2 photocatalytic research") as per recent studies and publications in scientific journals by Iowa State University.

Other tests conducted by the IPS in Queens, the University of Ferrara, Louisiana State University, Washington State University, Stony Brook University and Iowa State University are available to prove the quality of PURETi

Evolution of Technology

- **1968 Gen 1 - Powder based** PCO discovered at U. of Tokyo
- **1998 Gen 2 - Wet Process** PCO discovered at Saga, Japan
- **2004 Gen 3 -** Fotocatálisis **Aqueous perfected** and patented by PURETi
- **2016 Cristal and PURETi** Announce **Strategic Partnership** to Promote New Applications of **CristalACTiV™ Photocatalytic Materials**



nanoair SOLUTIONS

Why is Pureti better than its competitors?

Pureti uses CristalACTiV sol technology so it can be more efficient than any other competitor. The photocatalysis process occurs on the surface and the soltechnology is the best considering the following comments and graphs:

The development of photocatalysis has been given widespread attention in recent years as it is being used in all types of products in a wide range of areas, particularly including fields related to the environment and energy.

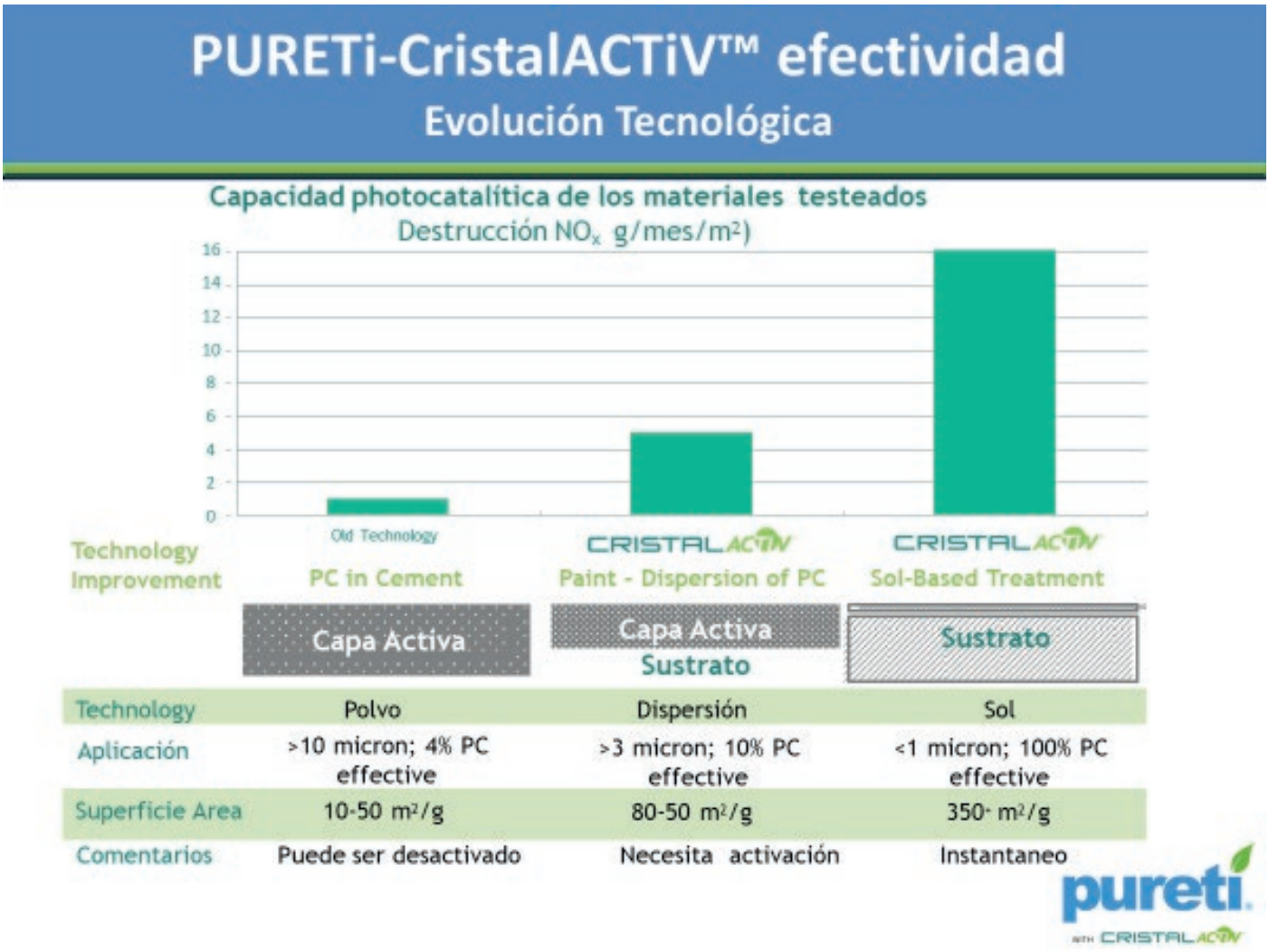
Following the discovery of the dissociation of the water molecule by Fujishima and Honda in 1972, the photocatalytic properties of certain materials have been used to convert solar energy into electrons and vacant places after the absorption of ultraviolet (UV) light. They have also been used to produce chemical energy to oxidize and/or reduce materials to obtain other useful materials such as hydrogen and hydrocarbons and to destroy or eliminate contaminants and bacteria on wall surfaces as well as in the air and water.

Of the many types of photocatalytic materials, TiO2 has been one of the most highly studied and used in a number of applications given its power as an oxidizer to decompose organic contaminants, hydrophilicity, chemical stability, long durability, non-toxicity, low cost and apparent transparency.

There are many factors that significantly influence the yield of photocatalytic materials and products. They include the particle size, the specific surface area, the pore volume, the pore structure, the crystalline phase and the facets of the exposed surfaces.

PURETI material has been developed and optimized to maximize the specific surface area, pore volume, pore size and dispersion level when applied in such way that these properties increase the size of the accessible surface area and, as a result, the mass transfer rate for the absorption and decomposition of organic contaminants. The combined effect of these factors results in enhanced photocatalytic performance as the photocatalytic reactions are based on chemical reactions on the surface of the photocatalytic material. In addition, these structural factors increase the light collection capacity by allowing the greatest amount of light to interact with the greatest surface area.

Given that photocatalytic reactions are based on chemical reactions on the surface of the material, only very fine layers are needed for the best results. With a very thick layer, not even UV light could activate molecules further down than a certain depth and decomposing organic compounds would not be in contact with the surfaces where the chemical reactions occur. This is the case of some photocatalytic or cement-based paints where the same product substrates shade the titanium dioxide particles from the light. It's like putting an awning above a sun clock.



PURETi – Use the Power of Light to Clean ™

PURETi is an American manufacturer of the world's safest, strongest, most versatile and credentialed photocatalytic products

- NASA **Dual Use Technology Partner**
- NIOSH **Nano Safety Testing Collaborator**
- Cristal **Global Technology Partner**
- Queens IPS **Preferred Solutions Provider**
- iSCAPE EU Horizons 2020 **Partner**

- ✓**2011 Popular Science CleanTech Innovation of the Year**
- ✓**2012 Edison Award for Material Technology**
- ✓**2012 Index Award for Sustainable Design**
- ✓**2013 Architectural Products Innovation Award**
- ✓**2013 Katerva Award Sustainability**
- ✓**2015 ISS Product Innovation of the Year**
- ✓**2017 NWU DoE Solar Decathlon Partner**

Cristal and PURETi Partnership Press Release

Date: 3/17/2016
Contact Name: Amy Drusano, Global Manager - Corporate Communications, Cristal, Karen Olszewski, PURETi Marketing Director
Contact Number: 410.229.8062, 513.290.3482

News Archive
Events
Publications
Media Room

Hunt Valley, MD and New York, NY

Cristal and PURETi Announce Strategic Partnership to Promote New Applications of CristalACTiV™ Photocatalytic Materials

(March 21, 2016) Cristal, a leading supplier of ultrafine titanium dioxide, and PURETi Group, a leading manufacturer of advanced photocatalytic surface treatments, today announced a joint technology and market development partnership to accelerate and promote applications of photocatalytic materials.

The numerous environmental benefits of light-activated titanium dioxide are well-documented. In the presence of UV-A light, surfaces coated with photocatalytic TiO2 oxidize organic pollutants. Photocatalytic surfaces resist the buildup of organic grime and also act as air purifiers that destroy airborne pollutants such as volatile organic compounds (VOCs) and nitrogen oxides (NOx), both harmful respiratory pollutants.

Winners of the iSCAPE Project to reduce Pollution in European Union

68 University consortiums participate in the public tender. Totalling circa 500 EU universities and 50 private firms.We were the winners!!:

Trinity College Dublin (IRE)+ M.I.T. (USA), Universita di Bologna (IT), University of Surrey (UK), Ilmatieteen Laitos (FIN), Universiteit Hasselt (BEL), Technische Universitat Dortmund (GER), JRC -Joint Research Centre- European Commission (BEL), Institut d'Arquitectura Avançada de Catalunya (ESP), T6 Ecosystems srl (ITA), **Nanoair Solutions .**

The iSCAPE Has been recently nominated among the 10 most disruptive technologies for the next 60 years in the European Union

https://horizon-magazine.eu/article/10-breakthroughs-shape-europe-next-60-years_en.html

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