



Using Light to Clean Air™

H.O.P.E

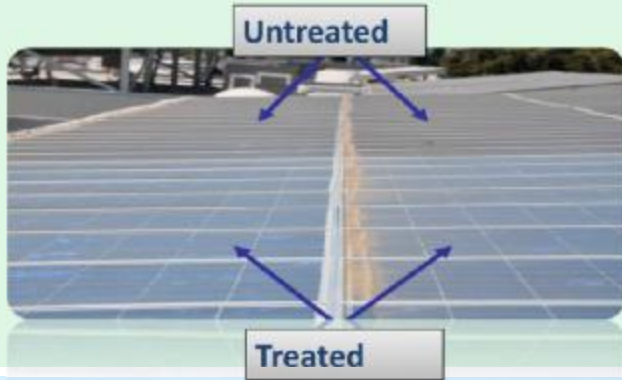
Health Optimizing Photocatalytic EcoSystem

Company Overview

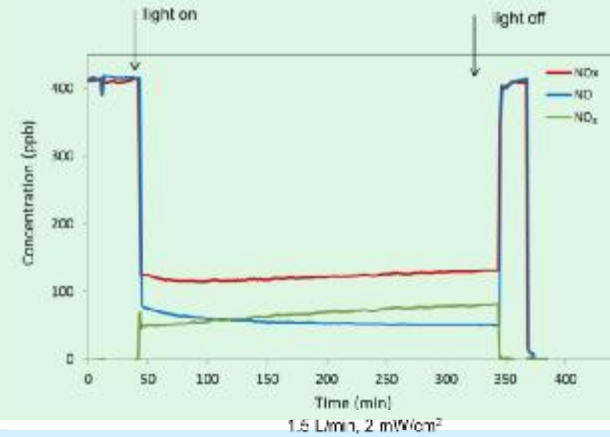
- PURETi Group, LLC is an American clean-tech company that manufactures water based, surface modifiers containing photocatalytic titanium dioxide.
- NASA validated, leading edge technology transforms ordinary surfaces into **light-activated, self-cleaning, air purifiers**.
- Customers use PURETi solutions to produce a variety of health, economic, and environmental benefits:
 - **Improve Human Health: Reverse air pollution, inside and out**
 - **Conserve Resources: Reduce water and chemical use**
 - **Improve Appearance and Customer Experience**
 - **Reduce Maintenance Costs**

PURETi - Uses and Benefits

**Outdoor Surfaces Stay Cleaner, Longer.
Clean Half as Often in Half the Time.**



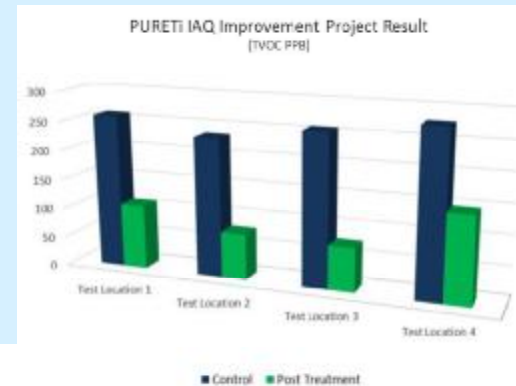
NOx in Outdoor Air Reduced by up to 70%.



**Labor Cost of Cleaning Glass and
Stainless Steel is Cut by 60% or More.**



**VOCs are Destroyed, Improving Indoor
Air Quality just by Treating Windows.**



Unsurpassed Credentials

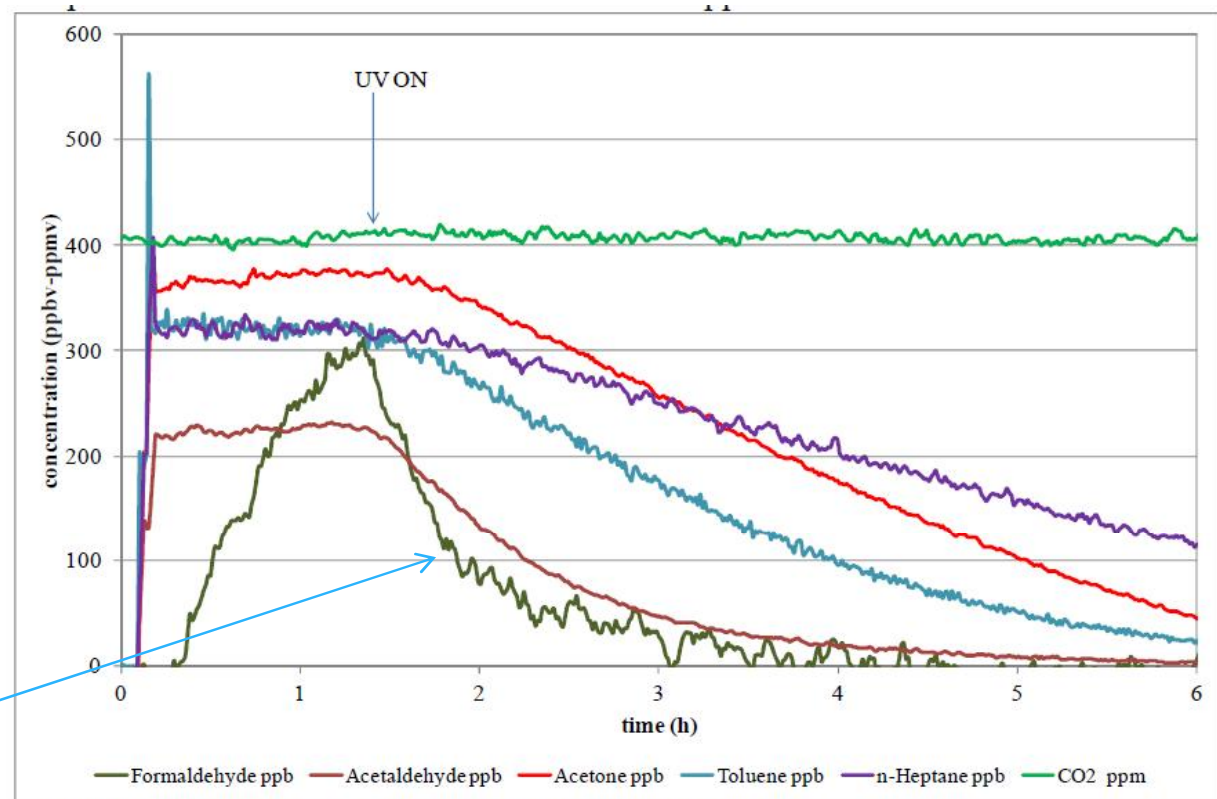
- PURETi's claims have been tested and proven at top national, university and independent laboratories, and the US Space Agency
 - Queens IPS, LSU, Stony Brook U., U. of Ferrara, Certech
- PURETi is a **NASA Dual Use Technology Partner**
- PURETi's safety profile has been tested and verified by multiple independent sources (NSF, NIOSH, Bureau Veritas).
- PURETi is the winner of 6 major awards for innovation in sustainability and environmentally beneficial products
- PURETi is the exclusive aqueous solutions partner of Cristal
- No other product of its kind has these credentials.



PURETi Destroys VOCs and Formaldehyde

In this controlled study, PURETi Clear on glass took only hours to reduce 5 different VOCs, by over 75%.

Formaldehyde was eliminated in 90 minutes.



Graph 2: VOC evolution versus time at low concentration.

Source: CERTECH asbl



PURETi Creates Bio-Protective Surfaces

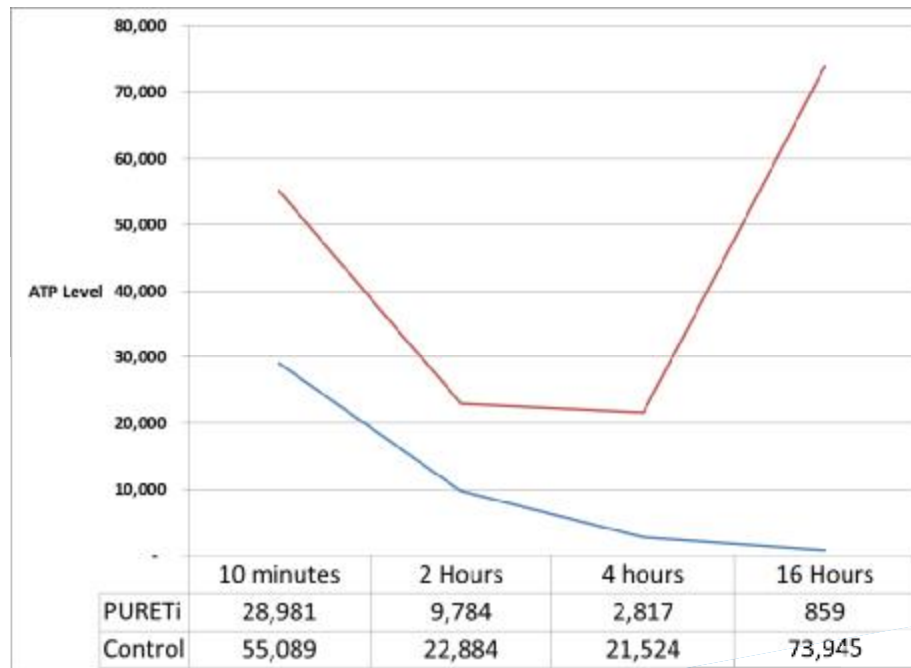
Test Method: ATP (an energy carrying molecule present in all living cells aka “the organic load”) levels are measured. ATP is PURETi is applied to half of clean ceramic or glass tile. Diluted milk is spread across tile. Tile is exposed to light. Low ATP levels = clean surface.

Result: ATP dropped 50% faster in 10 minutes on treated slide v control. **After 16 hours, organic load dropped 97% on PURETi slide;** while increasing 34% on control.

10 Minutes Control 55,089 / PURETi 28,981

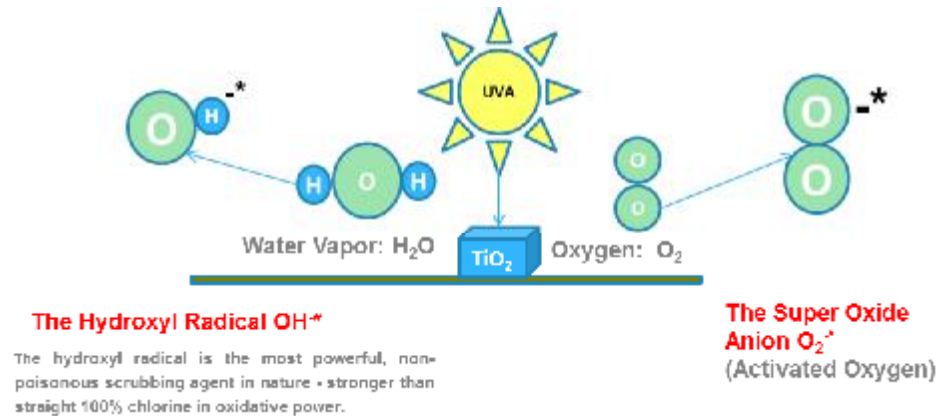


16 Hours Control 73,945 / PURETi 859



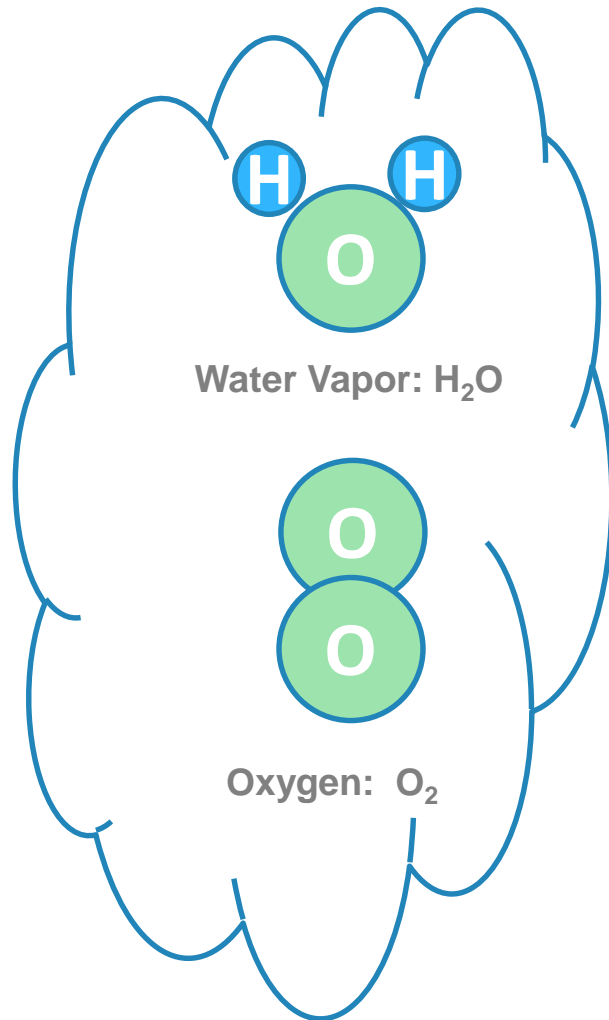
Appendix How it Works: Photocatalysis

- Photocatalysis is the opposite of photosynthesis: the light-accelerated breakdown of organic molecules.
 - The many potential applications of photocatalytic TiO_2 have been studied and anticipated for almost 50 years: pollution reversal, water purification, infection control, self-cleaning surfaces.
- When UVA light energy hits PURETi's TiO_2 , it starts a chemical process that turns nearby **oxygen** and **water vapor** into two powerful cleaning agents (OH^{-*} and O_2^{-*})

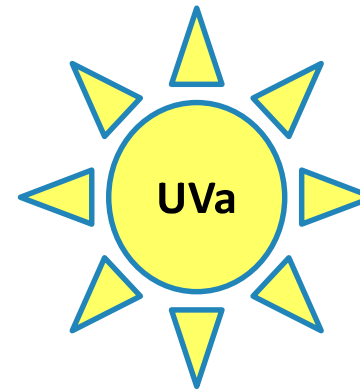


- These two cleaning agents convert harmful pollutants and grime into harmless minerals and gasses (CO_2) and then return to H_2O .
- The PURETi TiO_2 is a catalyst, so it is not consumed in the process. It continues to work as long as it is on the surface.
- The process happens only at the surface, and repeats billions of times to clean the surface and the air that comes in contact with it.

Photocatalysis: How It Works

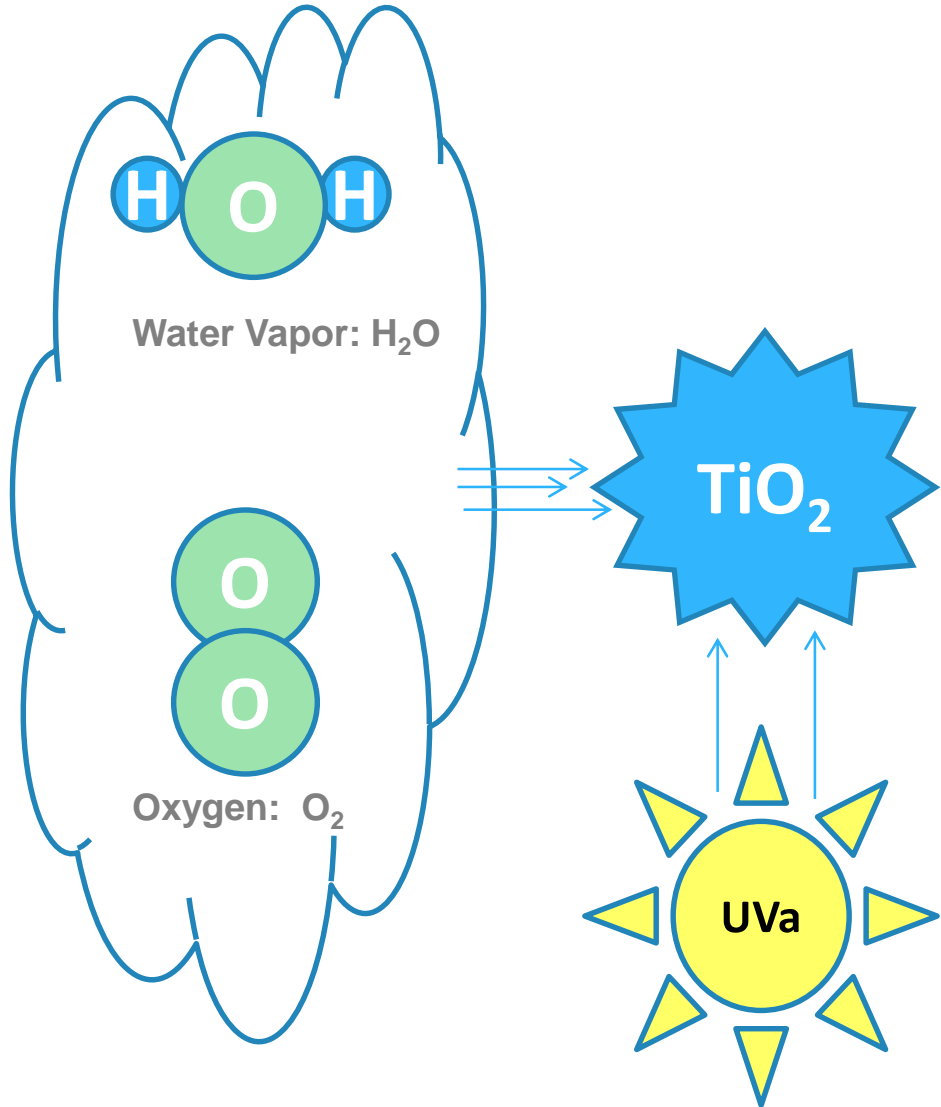


Water Vapor (in the form of humidity) and Oxygen are almost always present in the air.



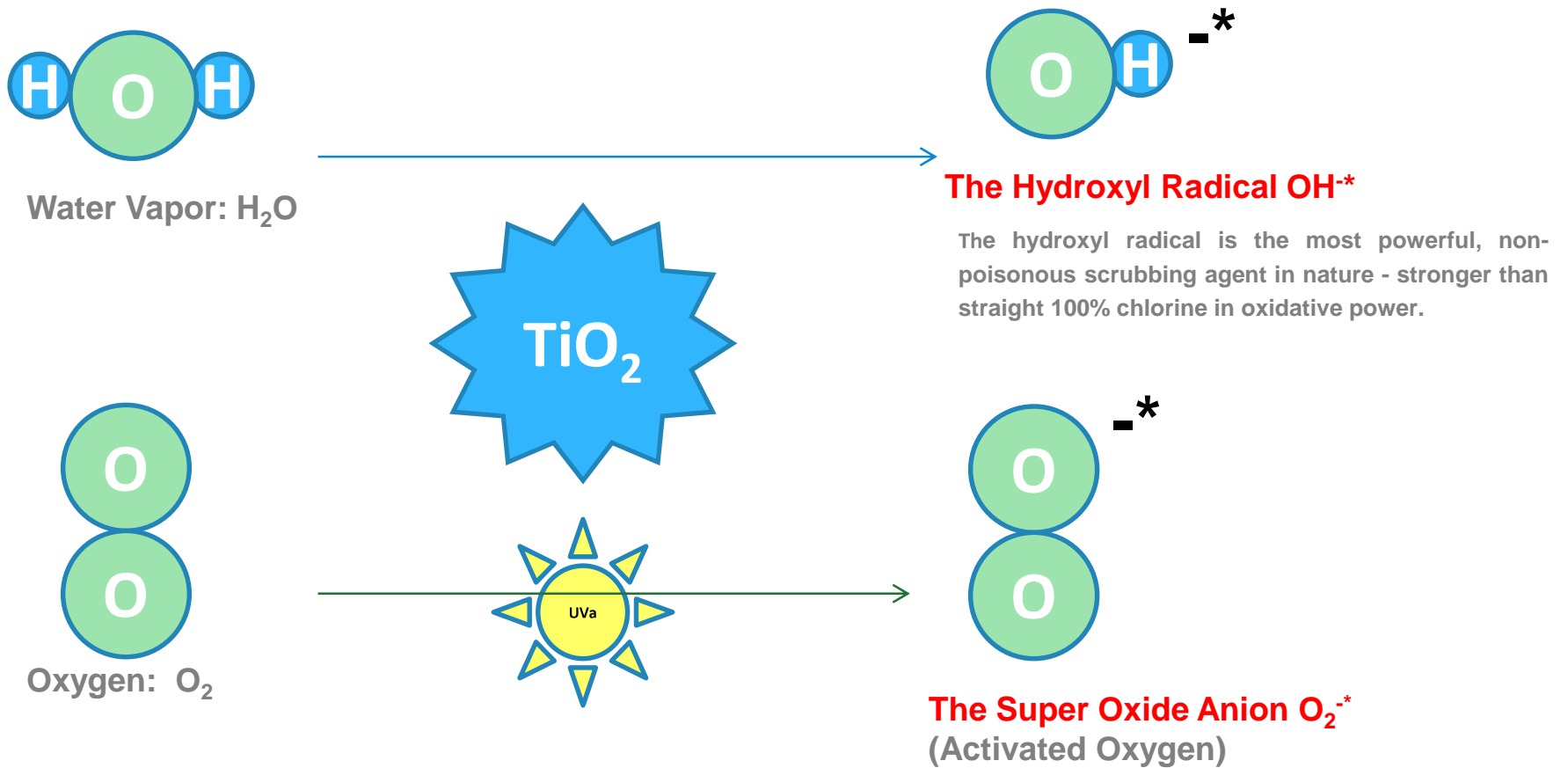
UVa Light is present in sunlight (direct or ambient) and many types of indoor lighting.

Photocatalysis: How It Works

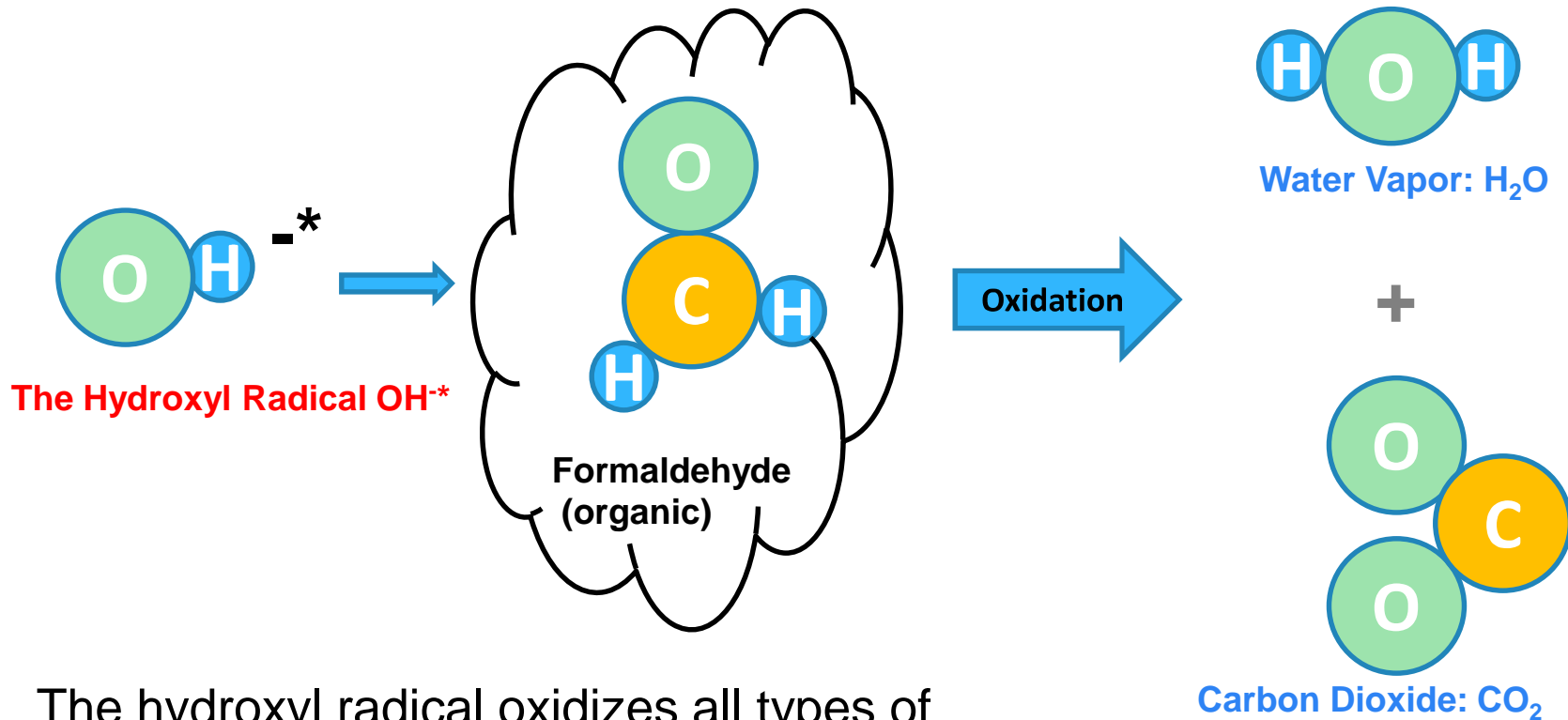


When UV-A light (aka black light or near visible light) strikes a TiO₂ crystal, the energy excites the crystal and causes any water vapor and the oxygen next to the crystal to change.

Photocatalysis: Creating 2 Powerful Cleaning Agents



Photocatalysis: Oxidation Reaction



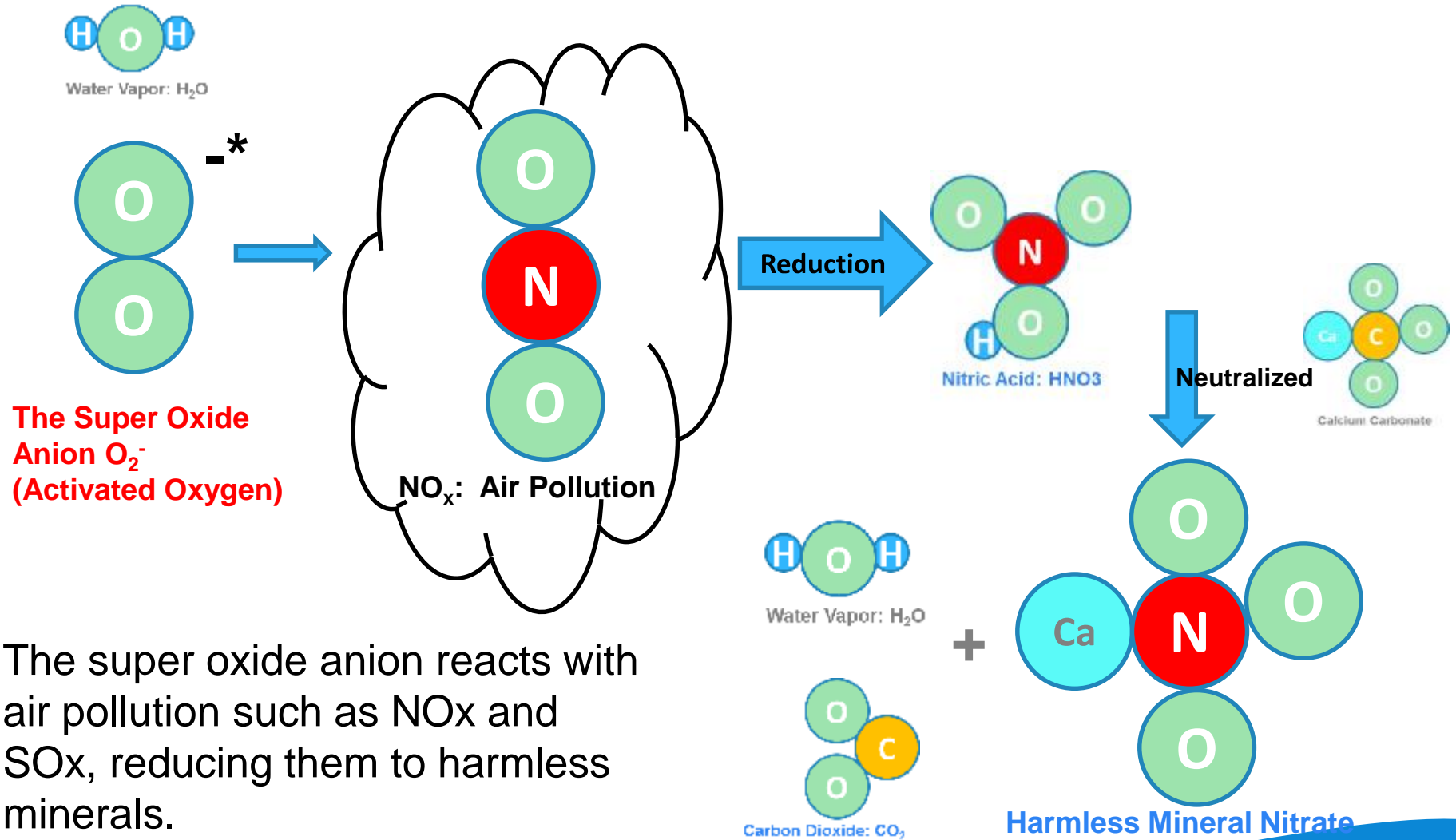
The hydroxyl radical oxidizes all types of organic compounds, including VOCs and formaldehyde, breaking them down to CO₂ and water vapor.

Photocatalysis: Some of the VOCs Oxidized

Class	Examples
Alkanes	methane, <i>iso</i> -butane, pentane, heptane, cyclohexane, paraffin
Haloalkanes	mono-, di-, tri- and tetrachloromethane, tribromoethane, 1,1,1-trifluoro-2,2,2-trichloroethane
Aliphatic alcohols	methanol, ethanol, <i>isopropyl</i> alcohol, glucose, sucrose
Aliphatic carboxylic acids	formic, ethanoic, dimethylethanoic, propanoic, oxalic acids
Alkenes	propene, cyclohexene
Haloalkenes	perchloroethene, 1,2-dichloroethene, 1,1,2-trichloroethene
Aromatics	benzene, naphthalene
Haloaromatics	chlorobenzene, 1,2-dichlorobenzene, bromobenzene,
Nitrohaloaromatics	3,4-dichloronitrobenzene, dichloronitrobenzene,
Phenols	phenol, hydroquinone, catechol, 4-methyl catechol, resorcinol, <i>o</i> -, <i>m</i> -, <i>p</i> -cresol
Halophenols	2-, 3-, 4-chlorophenol, pentachlorophenol, 4-fluorophenol, 3,4-difluorophenol
Aromatic carboxylic acids	benzoic, 4-aminobenzoic, phthalic, salicylic, <i>m</i> - and <i>p</i> -hydroxybenzoic, chlorohydroxybenzoic acids
Polymers	polyethylene, PVC
Surfactants	SDS, polyethylene glycol, sodium dodecyl benzene sulphonate, trimethyl phosphate, tetrabutyl ammonium phosphate
Herbicides	methyl viologen, atrazine, simazine, prometon, propetryne, bentazon
Pesticides	DDT, parathion, lindane
Dyes	methylene blue, rhodamine B, methyl orange, fluorescein, reactive black 5

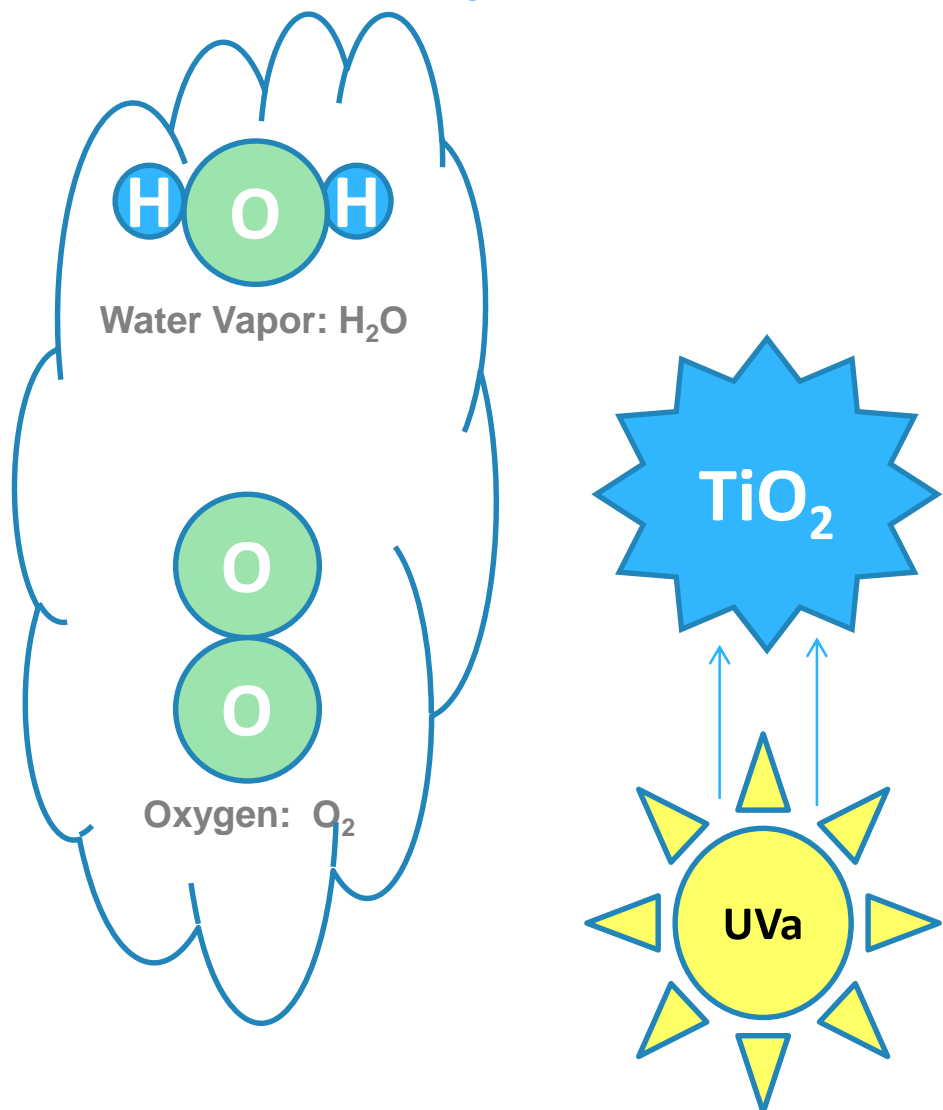
Source: Dr. Andrew Mills, IPS Belfast

Photocatalysis: The Reduction Reaction



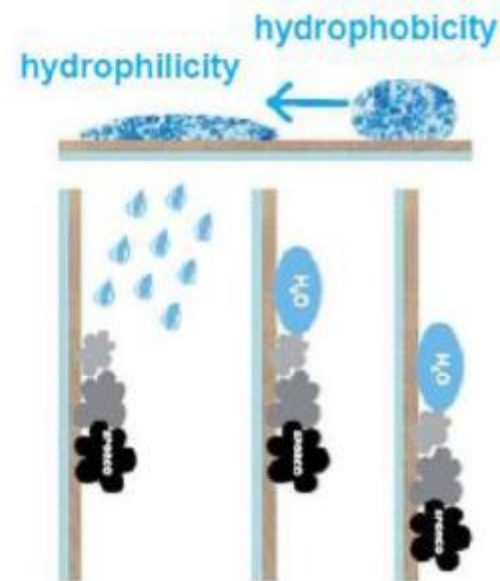
The super oxide anion reacts with air pollution such as NO_x and SO_x, reducing them to harmless minerals.

Photocatalysis: Continuous Action



- The process then starts again, and repeats until all pollutants are destroyed.
- The TiO₂ is never consumed in the process. This is one reason PURETi lasts so long.
- As long as there is light energy, the process will continue.

Hydrophilicity: Aides Outdoor Cleaning



- Water sheeting action helps outside surfaces stay cleaner.
- With all of the sticky organic grime oxidized, the hydrophilic properties of a PURETized surface make sand simply rinse away.
- If rain cannot reach the surface, it will need to be rinsed.

How Much Light is Needed?

- **The strength of the light** is measured in milliwatts per square centimeter.
- **PURETi photocatalytic solutions** require only 0.001 mW/cm² to eliminate odor indoors and just 0.10 mW/cm² to deliver a full self-cleaning benefit outdoors.
- **Outdoors** – there is >0.10 mW/cm² of UV-A light present in all daylight conditions – even the north side of buildings
- **Indoors** – there is normally more than 0.001 mW/cm² to **within one meter of windows and around fluorescent fixtures.**
- **You cannot see UV-A light, so you must use a meter to measure the light.**

Light is the Energy that Powers PURETi

- That is what makes it an environmentally friendly, sustainable solution
- But it is the most important constraint.
- Indoors, you must know your light levels before you can judge if PURETi will work

“No Light. No Fight”