NANOSCI

A Photocatalytic Engine

Groundbreaking Technology of Purifying the Air from Harmful Ingredients Such as Smog, Bacteria, Viruses and Fungi

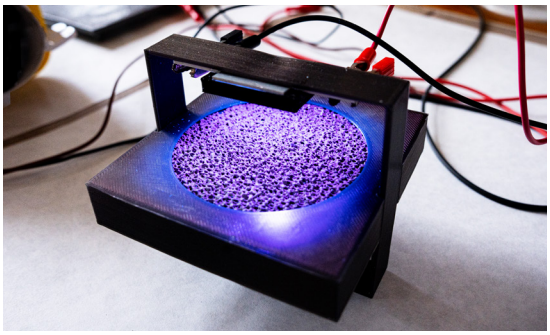
Photocatalysis

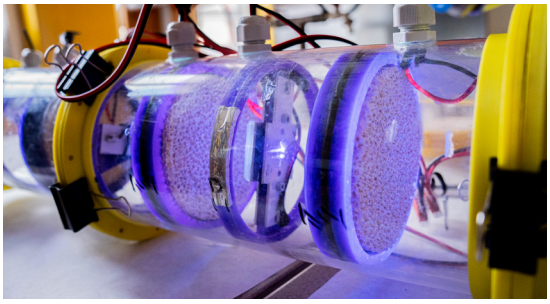
is a safe and sustainable method of air purification invented in the 1970s, which does not require the use of replaceable filters that retain pollutants. The technology developed by Nanosci is based on a process that uses ultraviolet radiation to excite a photocatalyst in the form of a ceramic porous material coated with nanoparticles.

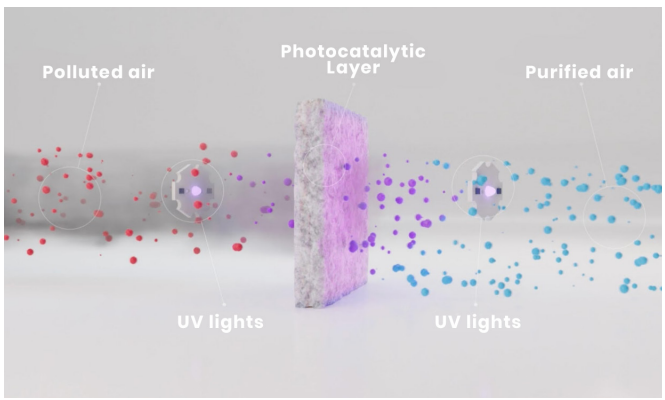
Adriana Zaleska-Medynska, PhD., CTO and co-founder of Nanosci, is a scientist with an internationally recognized reputation in the world of photocatalysis science. The photocatalytic engine, developed by the Nanosci team - led by Professor Zaleska-Medynska - is the culmination of over 20 years of work of scientists from the University of Gdańsk on the technology of photocatalytic air purification.

What are the benefits of using photocatalysis?

- **Savings:** trace costs of energy consumption (up to 3x less than UVC for air disinfection)
- **Versatility:** removes volatile organic and inorganic compounds from the air, gaseous components of smog (e.g. NOx, SOx), formaldehyde, as well as unpleasant odors or cigarette smoke, as well as pathogens such as viruses, bacteria and fungal spores
- **Efficiency:** removes 99.99% of air pollutants (*at linear velocity of air flow through the layer up to 2 m/s)
- **Maintenance-free:** no need to replace photocatalytic layers (unlike HEPA or carbon filters)
- **Flexibility:** purification components (photocatalytic layers) adapted to the shape of the final product
- **Durability:** longevity of up to 50,000 hours, as compared to 10,000 hours in the case of UV-C fluorescent lamps)
- **Safety:** people can stay in the room during purification, unlike with UV-C or ozonation







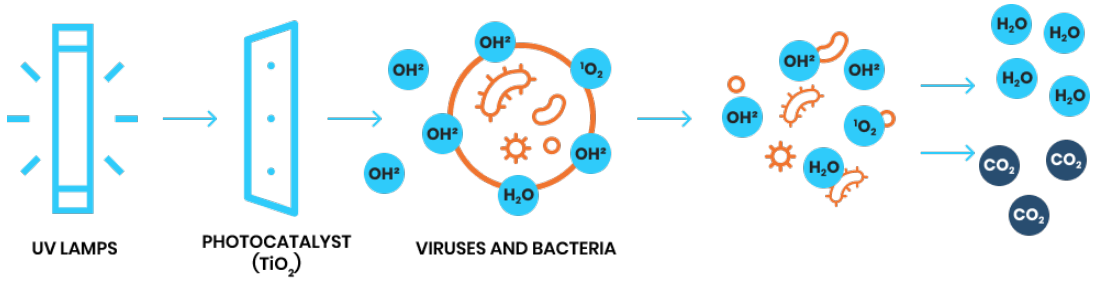
How does the photocatalytic engine work?

The polluted air is forced from the room into the engine by means of a fan. Then it is transported through a porous layer of ceramics covered with TiO_2 (titanium dioxide) nanoparticles and simultaneously irradiated with UV light emitted by LEDs embedded perpendicularly to the surface of the porous ceramics. The UV light stream effectively excites TiO_2 and degrades or inactivates impurities. The invented porous photocatalytic material is characterized by very high photocatalytic activity, good mechanical properties, and the ability to regenerate; it is also eco-friendly and easy to produce on a large scale.

Thanks to this, purifiers with photocatalytic technology do not accumulate pollutants, but completely destroy them. The solutions submitted to the Patent Office of the Republic of Poland allow for adjusting the purification technology to various industries, applications and shapes of target devices.

What does the pollutant decomposition process look like?

Free radicals + Oxygen + Pathogens ⟶ Carbon dioxide + Water + Trace elements

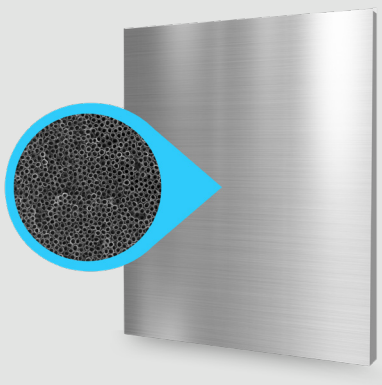


1. **Nanoparticles from the photocatalyst** are irradiated with appropriate energy (e.g. titanium dioxide by UV light)
2. **Photogenerated electrons** react with surrounding oxygen and air humidity forming reactive oxygen species, including strong hydroxyl radicals
3. **Radicals** oxidize organic compounds such as organic pollutants, causing them to mineralize, forming carbon dioxide, water, and finally simple inorganic compounds containing heteroatoms
4. **Nitrogen oxides (NO_x)** can be converted to HNO_3 or N_2, respectively, while sulfur oxide (SO_2) can be oxidized to sulfates
5. **Formed both nitrates (NO_{3-})** and sulfates (SO_4^{2-}) penetrate and accumulate in the layers of the photocatalyst

What is the application of photocatalysis?

Photocatalysis is successfully used to remove from the air:

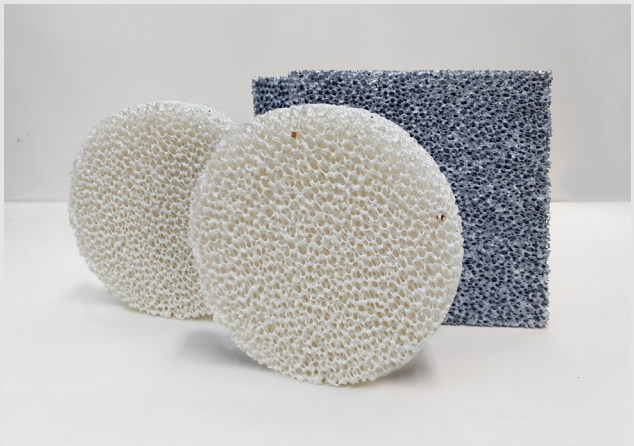
- **Gases** (e.g. smog components such as sulfur dioxide, nitrogen oxides and carbon monoxide)
- **Volatile organic and inorganic compounds**
- **Unpleasant odors** (e.g. cigarette smoke)
- **Pathogens** (viruses, bacteria and/or fungal spores)



Porous layers coated with photocatalytic nanomaterial

How safe is our technology?

User safety is our priority. Photochemical reaction takes place exclusively on the surface of the photocatalytic layer without any emission of titanium dioxide (TiO_2) nanoparticles. Therefore, there is no possibility for the nanoparticles to get into the respiratory system causing irritation. Reactive oxygen species in the form of hydroxyl radicals are not transported with the air stream due to their very short lifespan (about 10^{-8} to 10^{-9} seconds). Thus, they are completely safe to users.



Photocatalytic layers