Photocatalysis

The activity of the hydroxyl radical (• OH) is based on its participation in chemical transformations in a living cell. As a strong oxidizing agent, hydroxyl radicals break every CH bonding and damage proteins and nucleic acids. The lifetime of a hydroxyl radical in a biological environment ranges from 2×10^{-9} to 8×10^{-9} seconds, and the diffusion radius is <0.01 μm.
The cytotoxic and carcinogenic effect of ionizing radiation on living organisms is directly related to the formation of (• OH) during water radiolysis.

The process of photocatalysis on a nanocrystalline semiconductor titanium dioxide takes place according to the following scheme:
When TiO2 is irradiated with ultraviolet light, a light quantum knocks an electron out of the TiO_2 lattice and forms an electron gap ("hole").
An electron and a "hole" are created on the TiO_2 surface and are captured by it.

(TiO_2) + hv (h +) + (e-) [1]

Both particles are chemically active, so that the TiO_2 surface becomes a strong oxidation field. Various chemical and physical processes that lead to the formation of reactive oxygen species (ROS) can take place in the photocatalysis zone.
Upon contact with the TiO_2 surface, the oxygen in the ambient air binds a free electron. This is how the superoxide radical anion (• O_2-) is created.

(O_2) + (e-) (• O_2-) [1]

It was discovered [1] that the superoxide radical anion (• O_2-) can oxidize any organic compound to water and carbon dioxide.
It is known that molecular oxygen rarely triggers the oxidation of pollutants in the gas phase. Studies show that the main role in the oxidation processes in the gas phase play free radicals, among which the hydroxyl radical (• OH) should be differentiated.
In a photocatalytic reactor, a "hole" interacts with water to form a hydroxyl radical that also forms hydrogen:

(H2O) + (h +) (• OH) + (H) [2]

The resulting hydroxyl radical reacts immediately with every oxidizable molecule in the immediate vicinity [2]. These can not only be components of anthropogenic origin - volatile organic compounds, but also components of natural origin that are constantly present in the ambient air - CO, O_3, CH_4, C_2H_6, N_2O, etc. Their natural concentrations are such that the lifetime of the Hydroxyl radicals formed by photocatalysis do not exceed microseconds and they cannot exceed the limits of photocatalytic air purification devices and therefore pose no danger to humans.

The safety of photocatalytic devices for human health can be confirmed by the received medical certificates for individual samples of devices and US patents for photocatalytic respiratory protective devices.

Definitions
OH - hydroxyl radical
TiO2 - titanium dioxide