Photocatalytic Oxidation (PCO)

Titanium dioxide (TiO_2) is a semiconductor photocatalyst with a band gap energy of 3.2 eV. When this material is irradiated with photons of less than 385 nm, the band gap energy is exceeded and an electron is promoted from the valence band to the conduction band. The resultant electron-hole pair has a lifetime in the space-charge region that enables its participation in chemical reactions. The most widely postulated reactions are shown here.

$OH^- + h^+$ _________> $.OH$

$O_2 + e^-$ _________> O_2^-

Hydroxyl radicals and super-oxide ions are highly reactive species that will oxidize volatile organic compounds (VOCs) adsorbed on the catalyst surface. They will also kill and decompose adsorbed bioaerosols. The process is referred to as heterogeneous photocatalysis or, more specifically, photocatalytic oxidation (PCO).

Several attributes of PCO make it a strong candidate for indoor air quality (IAQ) applications. Pollutants, particularly VOCs, are preferentially adsorbed on the surface and oxidized to (primarily) carbon dioxide (CO_2). Thus, rather than simply changing the phase and concentrating the contaminant, the absolute toxicity of the treated air stream is reduced, allowing the photocatalytic reactor to operate as a self-cleaning filter relative to organic material on the catalyst surface.

Photocatalytic reactors may be integrated into new and existing heating, ventilation, and air conditioning (HVAC) systems due to their modular design, room temperature operation, and negligible pressure drop. PCO reactors also feature low power consumption, potentially long service life, and low maintenance requirements. These attributes contribute to the potential of PCO technology to be an effective process for removing and destroying low level pollutants in indoor air, including bacteria, viruses and fungi.

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