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Titanium dioxide based nanophotocatalysts : A boon to environmental remediation

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Nanotechnology is a promising field of environmental remediation based on the development of effective nanomaterials. The photocatalytic method offers a promising tactic to address the challenge of pollutant removal. The main features of nano photocatalysts for environmental remediation are excellent stability and photocatalytic activity. This manuscript primarily aims to present the advantages of using titanium dioxide (titania) based nano photocatalysts in environmental remediation. Titanium (IV) oxide in its mineral form has been found as a potential photocatalyst due to its favourable physicochemical properties. Among the synthesised nano photocatalysts, titanium dioxide-based nano photocatalysts are intended to remove groundwater pollutants such as organic pollutants, antibiotics and synthetic dyes from pollution sources. It is also inevitable to develop new technologies that utilise renewable energy sources for environmental cleanup.   As industrialisation accelerates, so does the energy demand of the retrofitting process. Retrofitting is the process of changing the pre-structured system or structure, which is mainly done to enhance the safety and strengthen the conditions of the system. Therefore, nano photocatalysts will benefit future environmental remediation applications. Titanium dioxide-based nano photocatalysts have attracted more attention due to their suitable band gap energies for trapping UV-visible light. The synthesis of titania-based nano photocatalysts is much easier with applications in various industries. Introducing new materials into the titanium dioxide structure changes its properties in some way. Newly developed titania-graphene nano photocatalysts are reported to be superior to pure titania nanoparticles in photocatalytic degradation of the organic pollutant phenol. Recently, environmental pollution by pharmaceutical industries has increased. The photocatalysis mechanism helps to eliminate antibiotic pollutants and has been considered an inexpensive and effective method. In a study, fluoroquinolone (antibiotics) containing N-piperazinyl and cardiovascular tablets with lengthy fragrant aspect chains, were suggested to be degraded via way of means of the nano photocatalyst of titanium dioxide-oxygen or nitrogen-related heptazine base polymer.   Thus, photocatalysis has gained a lot of interest as the nano photocatalyst degrades pollutants with mild radiation. It has the catalytic interest to degrade ten different types of pharmaceuticals. The vital impact of the nano photocatalyst is lowering the poisonous impact of the pollutants present in the polluted water. Also, the antibiotic metronidazole can be degraded quickly and more effectively under UV-C light using nano-photocatalyst titanium dioxide-iron(III). Tin (Sn) metal-coordinated titanium dioxide nanoparticles supported on activated carbon are effective catalysts for the decomposition of industrial dyes such as the azo dye, Orange G. The addition of metals to titanium dioxide greatly improves the photocatalytic activity. Although many nano-photocatalysts are still being developed and researched, they exhibit superior catalytic activity compared with titania-based nano-photocatalysts. Indeed, titanium-based nano photocatalysts will benefit environmental remediation in the future.

Keywords: Nano photocatalyst, Photocatalytic degradation, Titanium dioxide, Nanomaterials, Groundwater remediation

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