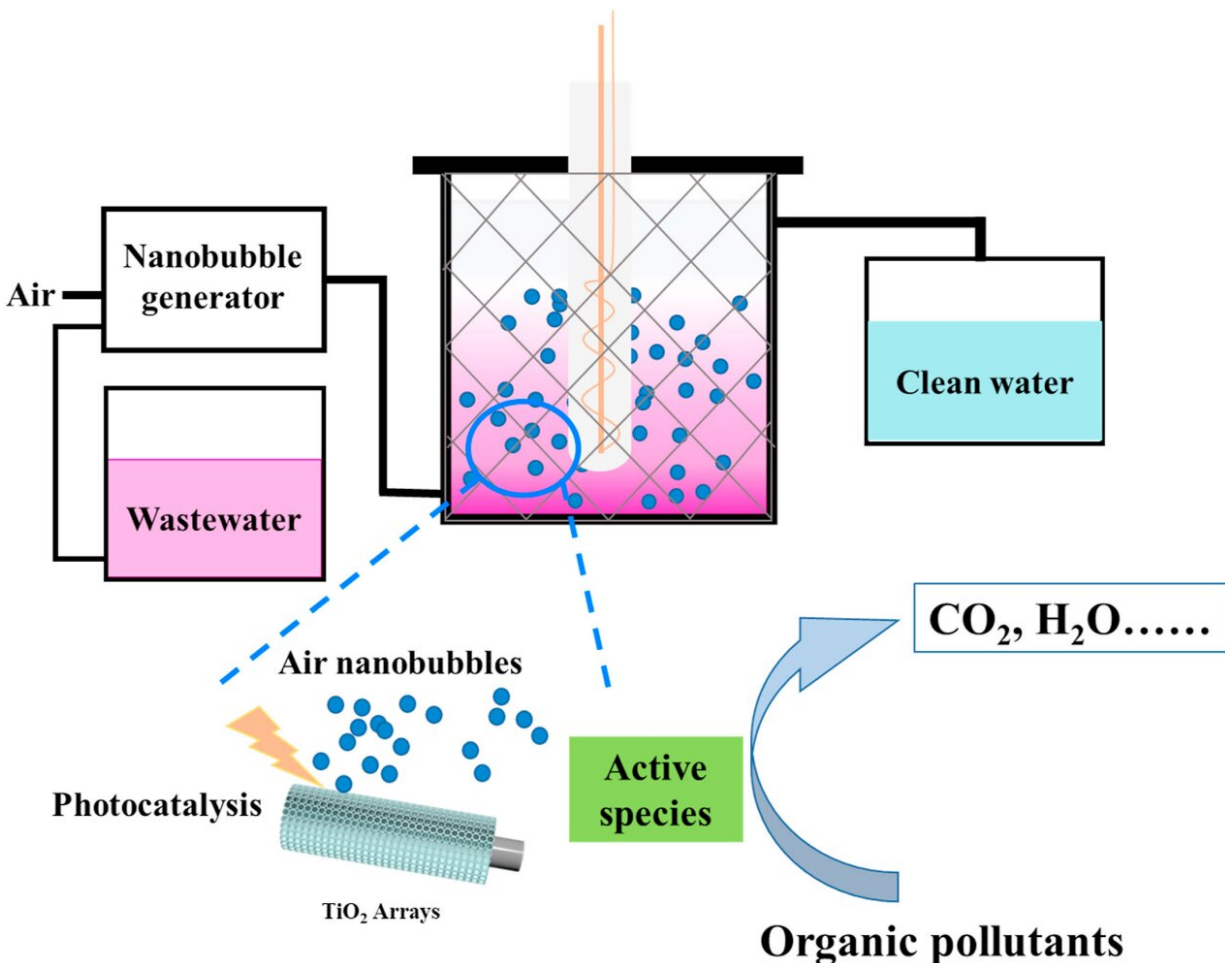


Photocatalytic technology improved with TiO₂ nanotube arrays and nanobubbles

May 16 2023



The cylindrical reactor was made of stainless steel with a diameter of 210 mm and a height of 210 mm. The Ti meshes (100 mm in length, 100 mm in width, and 0.5 mm in thickness) coated with TiO₂ nanotubes Arrays were fixed inside the reactor. A 100 W high-pressure mercury lamp (HPML) was placed inside the quartz tube. In addition, the inlet and outlet were designed on the left and right

sides of the reactor respectively. The inlet was connected to a nanobubble generator. The wastewater was pumped into the bubble generator to prepare the nanobubble-containing wastewater before entering the photocatalytic reactor. Art by Han's group. Credit: Beijing Zhongke Journal Publishing Co. Ltd.

With the rapid development of urbanization and industrialization, environmental problems became increasingly serious. Dye wastewater is considered to be one of the biggest challenges due to its high toxicity. Organic dyes have mutagenic, teratogenic, and carcinogenic properties, and threaten the health and life of humans while hindering plant photosynthesis, which brings risks to the ecosystem. Traditional organic pollutant treatment methods include the physical method, biological method, and chemical method.

These methods have drawbacks including poor efficiency, high energy consumption, and incomplete treatment, so it is necessary to develop new sewage treatment methods. In 1972, Fujishima performed the pioneering work of [photocatalytic](#) decomposition of water to produce hydrogen using TiO_2 as a photocatalyst. After that, photocatalytic technology was developed for [sewage treatment](#) due to its advantages of superior mineralization ability, fast reaction rate, and no secondary pollution.

TiO_2 is a common photocatalytic material because of its high catalytic activity, non-toxicity, excellent chemical stability, and low cost. In order to apply TiO_2 photocatalytic technology, it is essential to design a photocatalytic reactor with a simple structure, convenient assembly and outstanding treatment performance.

In recent years, photocatalytic technology has been coupled with various advanced oxidation processes (AOPs) to improve photocatalytic

performance. TiO₂-based photocatalytic technology coupling with classical AOPs such as Fenton oxidation, plasma oxidation, and ozone oxidation was reported to improve the treatment of [organic pollutants](#).

Nanobubbles (NBs) are extremely small gas bubbles with unique physical properties, which make them a superior aeration method for many applications. Nanobubbles have been widely used in [wastewater treatment](#) due to their long residence time, large specific surface area, and free radicals generation ability. The researchers designed a UV/NBs/P₂₅-TiO₂ photocatalytic reactor to degrade methyl orange in water. The results showed that the photocatalytic performance of TiO₂ coupling with nanobubbles is enhanced by 11.6% compared with that without bubbles.

However, the TiO₂ photocatalyst needs to be re-separated and recovered after photocatalytic degradation, which was unfavorable to the design of the photocatalytic reactor. Therefore, the fixed photocatalyst was required for assembling the photocatalytic reactor.

A photocatalytic reactor was assembled using a Ti mesh coated with TiO₂ nanotube array to degrade organic pollutants. The reactor coupling with nanobubbles technology showed outstanding photocatalytic degradation ability, with a degradation efficiency of Rhodamine B (RhB) of 95.39% after irradiation treatment. The other organic pollutants including methylene blue, tetracycline, and oxytetracycline hydrochloride were all photodegradable using this photocatalytic [reactor](#), with degradation efficiencies of 74.23%, 68.68%, and 64.10%, respectively. Therefore, this work provides a strategy to develop a coupling technology of photocatalysis and nanobubbles to treat wastewater.

The study is published in the journal *Advanced Sensor and Energy Materials*.

More information: Zesen Lin et al, Degradation of Rhodamine B in the photocatalytic reactor containing TiO₂ nanotube arrays coupled with nanobubbles, *Advanced Sensor and Energy Materials* (2023). [DOI: 10.1016/j.asems.2023.100054](https://doi.org/10.1016/j.asems.2023.100054)

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Citation: Photocatalytic technology improved with TiO₂ nanotube arrays and nanobubbles (2023, May 16) retrieved 4 August 2024 from <https://phys.org/news/2023-05-photocatalytic-technology-tio2-nanotube-arrays.html>

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