Titania-based photocatalysts for water treatment

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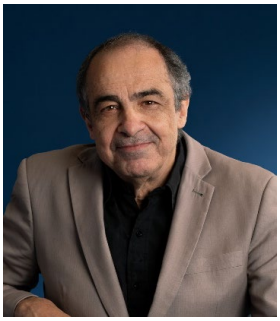
Abstract

Photocatalysis technology has attracted significant attention as a potential strategy for eliminating the persistent pollutants in the aquatic environment and for green hydrogen production (i.e. water splitting). However, low photocatalytic efficiency and separation of photocatalyst nanoparticles from colloidal dispersions remain critical challenges. To address these bottlenecks, we used laser-induced plasmas to develop highly efficient thin film-based immobilized photocatalysts. In particular, six-layer multiple-homojunction nitrogen-gradient doped TiO_2 (g-N-TiO_2) was fabricated with highly improved photocatalytic performance for water purification and photocurrent generation compared to bare TiO_2 and simple doped N-TiO_2. The improved performance of g-N-TiO_2 was attributed to the 1D structure, high-quality interfaces and extended internal electric field that facilitated charge-carrier transport and separation. To further improve the photoconversion efficiency, $BiVO_4$ was grown on the outermost surface of black titanium oxide nanotube arrays, which yielded a high unassisted photocatalytic removal efficiency for a hard-to-treat antibiotic under visible light irradiation. The high removal efficiency was due to the 1D structure, the formation of a type II heterojunction, and the deposition of a thin $BiVO_4$ layer (thickness lower than charge carriers' diffusion length) without blocking the nanotubes.

Biography



Mohamed Chaker has been a professor at the Institut National de la Recherche Scientifique (INRS) in Varennes, Quebec, Canada since 1989. He held a Tier 1 Canada Research Chair in Plasmas applied to micro and nanomanufacturing technologies from 2003 to 2024 and published over 360 articles in peer-review journals (19765 citations, H-index=76 according to Google Scholar) in various domains, including advanced plasma sources characterization (high-density plasmas and laser-induced plasmas) for applications to thin film and nanomaterials synthesis, nanometer pattern transfer and device fabrication. From 2005, he is the director of the Laboratory of Micro and Nanofabrication (LMN) of INRS.

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