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TiO_2 and Au-TiO_2 Nanomaterials for rapid photocatalytic degradation of antibiotic residues in aquaculture wastewater and river water samples

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Abstract

Antibiotic residues in aquaculture wastewater and river water samples are considered as an emerging environmental problem, as they are not efficiently removed in wastewater treatment plants. To solve this issue, we fabricated TiO2 nanotube arrays (TNAs), TiO2 nanowires on nanotube arrays (TNWs/TNAs), Au nanoparticle (NP)-decorated-TNAs and TNWs/TNAs, which were applied for assessing the photocatalytic degradation of eight antibiotics, simultaneously. The TNAs and TNWs/TNAs were synthesized by anodization using an aqueous NH4F/ethylene glycol solution. Au NPs were synthesized by chemical reduction method and used to decorate on TNAs and TNWs/TNAs. All the TiO2 nano structures exhibited anatase phase and well-defined morphology. The photocatalytic performance of TNAs, TNWs/TNAs, Au-TNAs and Au-TNWs/TNAs was studied by monitoring the degradation of amoxicillin, ampicillin, doxycycline, oxytetracycline, lincomycin, vancomycin, sulfamethazine and sulfamethoxazole under ultraviolet (UV)-visible (VIS), or VIS illumination by LC-MS/MSmethod. All the four kinds of nanomaterials degraded the antibiotics effectively and rapidly, in which most antibiotics were removed completely after 20 min treatment. The Au-TNWs/TNAs exhibited the highest photocatalytic activity in degradation of the eight antibiotics. For example, reaction rate constants of Au-TNWs/TNAs for degradation of lincomycin reached 0.26 min−1 and 0.096 min−1 under UV-VIS and VIS irradiation, respectively; and they were even higher for the other antibiotics. The excellent photocatalytic activity of Au-TNWs/TNAs was attributed to the synergistic effects of: (1) The larger surface area of TNWs/TNAs as compared to TNAs and (2) surface plasmonic effect in Au NPs to enhance the visible light harvesting.

Keynote: Photocatalytic nanomaterials, analytical chemistry, antibiotics, LC-MS/MS Method

Biography

He is a senior lecturer and a head of department of analytical chemistry and toxicology, pharmacy faculty, can tho university of medicine and pharmacy, Vietnam. He received his Ph.D. degree in analytical chemistry and toxicology from university of medicine and pharmacy at ho chi minh city, Vietnam, in 2015. During his doctoral study, he had 2-year study from Oct 2010 to Oct 2013 in innsbruck university, Austria. He is the author and co-author over 50 papers and is a PI of two national research projects. His research interests include: (1) antibiotic residues in hospital, aquaculture wastewater, industrial zone, urban wastewater environment analysis, (2) nanostructured materials for photocatalytic applications, (3) heavy metals residues in water, food and drugs, (4) bioavailability, bioequivalence, pharmacokinetic, therapeutic drug monitoring, (5) isolation of biological activity compounds as reference standards from medicinal plants, determination pharmaceutical substances, (6) food safety: pesticide residues in vegetables and medicinal plants, poisons in food.

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