Bio-TiO2 Nanoparticle-Impregnated Bacterial Cellulose for Water Treatment

Apiwatgaroon, Salisa (School: Kamnoetvidya Science Academy)
Pasuntaviroj, Nicharee (School: Kamnoetvidya Science Academy)

This study examined a new kind of water treatment material derived from bio-TiO2 nanoparticle-impregnated bacterial cellulose (TiO2-BC) synthesized by an environmentally friendly method. The TiO2-BC can be used to effectively eliminate organic compounds from wastewater through photocatalytic reaction. Firstly, green synthesis of the bio-TiO2 nanoparticles using Jatropha curcas leaf extract yielded 20-50 nm TiO2 in anatase phase. Secondly, to improve the specific surface area and provide reusability of the TiO2 nanoparticles, the TiO2 NPs were impregnated into bacterial cellulose. Bacterial cellulose production using Gluconacetobacter xylinus is cost-effective and can be produced using culturing medium containing waste coconut water, which is an agricultural waste generally found in Thailand. Impregnation of TiO2 in bacterial cellulose was performed by sonication of a suspension containing TiO2 and bacterial cellulose followed by freeze-drying. Photocatalytic properties of TiO2-BC for treatment of organic compounds in water were observed from the decomposition rate of methylene blue (MB) with UV-visible spectrophotometry. The results showed that the rate of MB decomposition corresponded well to the concentration of TiO2 suspensions up to 0.01 M. The repeatability test showed that MB decomposition rate by the TiO2-BC did not decrease when the material was reused twice. For application with real contaminated water, high COD removal was obtained by using TiO2-BC under sunlight. These results suggest the development of the environmentally friendly material that can be used for water treatment with higher efficiency in the future.