One-dimensional Catalysts for Photocatalytic Conversions of Bioresources to High Value Chemicals and Fuels

Surawut Chuangchote*

Department of Tool and Materials Engineering, Faculty of Engineering,
King Mongkut's University of Technology Thonburi,
126 Prachauthit Rd., Bangmod, Thungkru,
Bangkok 10140, Thailand

E-mail: surawut.chu@kmutt.ac.th

Abstract

Bioresources, especially biomasses, are the important supplies for electricity, heat, chemicals, and fuels in agricultural countries, including Thailand. Bioresource conversion has attracted much attention as one of promising platforms to produce renewable energy and chemicals in the future. Biomass consist of hydrocarbon compounds like fossil fuels, but its chemical compositions are different. Hydrocarbon compounds in biomass have been used as intermediate platforms molecules to produce fuels and chemicals. In addition, its components have been widely applied in fabrication of bio-based materials for energy storage device and solar energy conversion, such as batteries, supercapacitors, and solar cells. Photocatalysis is one of the most promising technologies, that uses light with catalysts to convert various bioresources to high value chemicals and fuels. TiO_2 is the most important photocatalyst that is used in many photocatalytic applications. It has been reported to be nanostructured in various forms, such as nanoparticles, nanorods, nanofilms, nanofibers, etc. One dimensional nanostructures, such as nanofibers, nanorods and nanotubes, have great basic properties, such as higher surface area, greater electron transfer, lower charge recombination, and easer recycling abilities, compared with the conventional particle- and film- formed materials. In this contribution, one-dimensional nanostructured TiO_2 were fabricated by solution processes. Important parameters of the fabrication processes were optimized to produce one-dimensional TiO_2 nanostructures with good properties, including small crystal phase, high crystallinity, and high surface area. Obtained one-dimensional TiO_2 nanostructures were characterized by scanning electron microscopy (SEM), transmission electron microscopy (TEM), BET-surface area technique, X-ray diffraction (XRD), UV-vis spectroscopy, and PL spectroscopy. Obtained TiO_2 nanostructures were utilized as photocatalysts for conversions of lignin, glucose, and water to high value chemicals and fuels (e.g. hydrogen). The modifications of TiO_2 nanofibers were carried out for improvement of the ability of visible light absorption and increasing efficiency of catalysts for enhancing high photocatalytic activity.

Keywords: one-dimensional nanomaterial, bioresource, photocatalyst, high value chemical, fuel.