Highly Efficient Photocatalytic Hydrogen Production by Liquid Phase Plasma Irradiation over TiO_2/Carbon Nanotube Photocatalysts

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Photocatalysis is an efficient method for hydrogen production because it can be obtained sustainably using solar energy. This process is attractive economically compared to other methods, such as a steam reforming process and water electrolysis [1]. Photocatalytic water splitting is effective for converting solar energy to hydrogen asa clean and renewable hydrogen energy [2]. The development of high photosensitive catalysts has been studied under UV and visible light illumination. In particular, visible light sensitive photocatalysts for hydrogen generation from water have attracted considerable attention. In addition, light sources are as important as the photocatalysts in a photochemical reaction. Although a range of light sources have been employed in photocatalysis, few studies have examined photocatalysis for hydrogen generation using liquid phase plasma (LPP) by irradiation into water directly.

This study examined hydrogen evolution by water photocatalysis using liquid phase plasma on metal-loaded TiO_2 photocatalysts. The photocatalysts were supported on carbon nanotube (CNT). The photocatalytic activities of the photocatalysts were estimated for hydrogen production from water. The rates of hydrogen evolution by LPP irradiation was compared with those of UV light irradiation on the same photocatalysts.

The photocatalysis was performed for water in air-free system connected to a gas chromatograph (GC). The gas products produced during the reaction were carried by N_2 carrier gas at a continuous flow to the GC at a 20 mL/min flow rate adjusted by a mass flow controller (MFC).

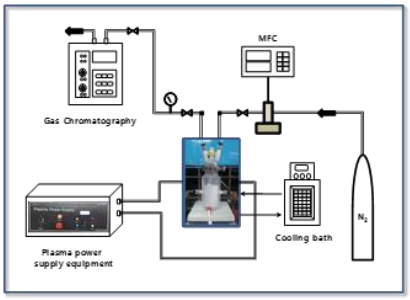

Fig. 1. Schematic diagram of photocatalytic reaction apparatus using LPP system.

The TiO_2/CNT photocatalysts was prepared by the wetness impregnation method in the TiO_2 sol. The metal-loaded TiO_2/CNT photocatalysts were prepared from the impregnation of metal ions on the surface of the TiO_2/CNT photocatalysts.

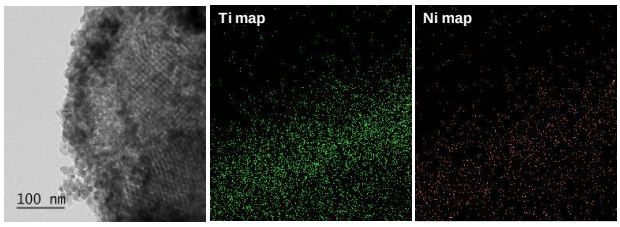

Fig. 2. TEM image and component mapping of Ni/TiO_2 supported onto CNT.

Hydrogen was produced from the water photodecomposition by LPP irradiation without photocatalyst. Photocatalytic activity was improved significantly with metal loading on the TiO_2. The TiO_2 nanocrystallites prepared by sol-gel method were incorporated above 40 wt% on CNT support. The CNT acted as an efficient photocatalytic support for the fixation of TiO_2. Hydrogen evolution was enhanced with metal incorporation over the TiO_2 supported on the CNT support. The rate of hydrogen evolution on the photocatalysis using the LPP was higher 5 times than the rate obtained from UV light-driven hydrogen generation.

REFERENCES

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