Preparation and photocatalytic performance evaluation of carbon nanostructured doped TiO_2 nanoparticles using liquid phase plasma treatment

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Titanium dioxide (TiO_2) has been generally considered as promising materials for environmental and energy applications because of their chemical stability, nontoxicity and abundance. In addition many methods including doping or compositing with various elements have been introduced to improve the photocatalytic properties of TiO_2. Among those methods, carbon doping has been proven to be a beneficial way to enhance the photocatalytic activity through the increase of adsorption amount of target molecules without decreasing the light intensity [1-4].

On the other hand, our previous work revealed that liquid-phase bipolar pulsed electrical discharge system can be applicable to synthesize the various nanoparticles with different physical and chemical properties [5, 6]. In this work, we have proven successfully that the liquid phase plasma method (LPPM) was useful to efficiently synthesize carbon doped TiO_2 nanoparticles. The detailed description of the LPPM can be found in Fig.1 [5, 6]

The samples prepared were characterized by using X-ray diffractometer, high resolution transmission electron microscopy, UV–vis diffuse reflectance spectra and X-ray photoelectron spectroscopy. In particular nitrogen adsorption analysis was used to compare the textural properties such as specific surface area, pore volume, pore size distributions and adsorption energy distribution functions of the parent TiO_2 and the nanostructured carbon doped TiO_2. The photocatalytic activity of the samples was evaluated using the decomposition rate of dye. A simplified Langmuir-Hinshelwood model was used to evaluate the photocatalytic degradation of dye molecules. Moreover, the optimum carbon amounts for enhancing the photocatalytic decomposition with the appropriate adsorptivity were examined.

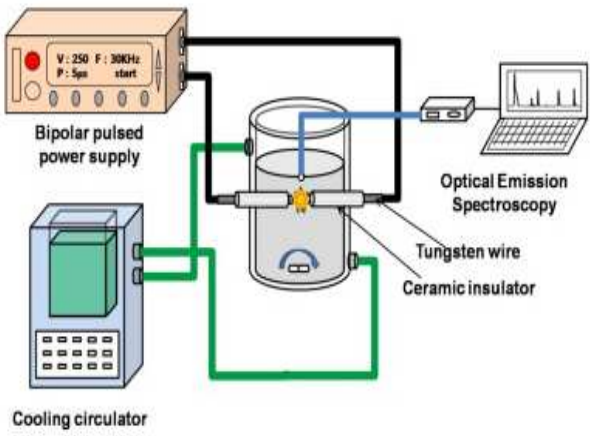

Fig.1 Schematic of liquid-phase bipolar pulsed electrical discharge system [5, 6].

In this work, we found that the photocatalytic activity of the carbon doped TiO_2 was much higher than that of the parent TiO_2. This result was substantially related with the enhancement of adsorption equilibrium amount and the effective charge separation. The present results clearly revealed that the liquid phase plasma treatment can be a potential process to efficiently synthesize the nanostructured carbon doped TiO_2 nanoparticles with relatively high adsorptivity and photocatalytic activity.

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