VIETNAM NATIONAL UNIVERSITY - HCMC
HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY

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DISSERTATION INFORMATION

Title: ***Synthesis of graphene aerogel-based nanocomposite materials for adsorption, photodegradation of organic dyes in water.***

Major: **Chemical Engineering** Major code: **9520301**

PhD candidate: **Truong Thi Phuong Nguyet Xuan Trinh**

Advisors: **1: Assoc. Prof. Dr. Mai Thanh Phong**

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Major Contributions of This Dissertation:

In this thesis, graphene aerogel (GA) and GA–based nanocomposite materials such as titanium dioxide/graphene aerogel (TiGA) and silver–titanium dioxide/graphene aerogel (ATGA) were synthesized and investigated the photodegradation with two types of organic dyes cationic (methylene blue – MB) and anionic (methyl orange – MO). The concentrations of MB and MO were determined by the method of ultraviolet–visible spectroscopy (UV–Vis). Three materials are synthesized by graphene oxide (GO) as precursor and ethylenediamine (EDA) as reducing agent, the detailed contents are as follows:

For GA: A suitable GA material was found based on the influence of two factors on GA's characteristics such as EDA volume and solvent ratio (water:ethanol) that were investigated. The adsorption capacity for cationic (MB) and anionic (MO) dyes of GA materials was also investigated through the adsorption capacity. The influence of factors such as time, pH, and initial concentration on the adsorption capacity of suitable GA was investigated. In addition, the adsorption kinetics of GA was also investigated through pseudo kinetic models (first and second order) and adsorption isotherm models (Langmuir, Freundlich, and Temkin). The recovery and reusability of GA material was investigated 5 cycles. At the same time, the adsorption mechanism of GA material was studied and proposed through the results of Fourier transform infrared spectroscopy (FTIR) analysis of the material before and after adsorption.

For TiGA: A suitable TiGA material was found based on the influence of the synthesis methods (hydrothermal and chemical reduction) and synthesis conditions (EDA volume, titanium (IV) isopropoxide (TIP) volume, temperature, and reduction time) on the photodegradation performance for MB, MO. At the same time, the influence of factors (pH, dye concentration, and amount of material) on the MB, MO photodegradation efficiency of suitable TiGA were also investigated by the method of alternating each variable. The stability of the material was investigated over 10 cycles of reuse for MB and MO dyes. In addition, the effect of free radicals in the photodegradation of TiGA materials on the photodegradation efficiency was investigated in order to propose the photodegradation mechanism of TiGA. The investigated free radical scavengers are isopropyl alcohol (IPA), p–benzoquinone (p–BQ), and ethylenediaminetetraacetic acid disodium salt (EDTA–Na2), respectively, for the •OH, •O2–, and h+ radicals, respectively.

For ATGA: A suitable ATGA material was also found based on the influence of the synthesis methods (hydrothermal and chemical reduction) and synthesis conditions (EDA volume, TIP:AgNO3 volume ratio, temperature, and reduction time) on the photodegradation efficiency for MB, MO. Besides, the influence of photodegradation factors (illumination distance, pH, adsorption time, photodegradation time, dye concentration, and material quantity) on the photodegradation efficiency of the materials. The suitable ATGA was investigated by response surface method, experimental design according to Plackett – Burman and Box – Behnken models. At the same time, the recovery and reusability of material was investigated over 10 cycles. In addition, the photodegradation mechanism MB and MO of ATGA material has been proposed through the investigation results of the influence of free radicals. The free radical scavengers were investigated in turn as for ATGA materials. The photodegradation efficiency of the material for dyes were evaluated through the results of analysis of the total organic carbon (TOC) in the solution. Furthermore, the stability of the materials after the photodegradation for the pigments were determined through the results of structural analysis, which are X-ray diffraction (XRD), and FTIR spectroscopy.

The characterization of the GA, TiGA, and ATGA were analyzed by advanced analytical methods, including XRD, FTIR, scanning electron microscope (SEM), energy–dispersive X–ray spectroscopy (EDS), transmission electron microscopy –

TEM, high–resolution transmission electron microscopy (HR–TEM), selected area electron diffraction (SAED), UV–Vis, and X–ray photoelectron spectroscopy (XPS).

Advisors		**Ph.D. candidate**
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