R&R, 2018

4th International Conference on Recycling and Reuse

Book of Abstracts

October 24-26, 2018
İstanbul - Türkiye

RECYCLING AND REUSE, 2018

4th INTERNATIONAL CONFERENCE
ON
RECYCLING AND REUSE

BOOK OF ABSTRACTS

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İstanbul / TÜRKİYE

October 24-26, 2018

4th International Conference on Recycling and Reuse, R&R 2018 (İstanbul, Türkiye)

İstanbul : İstanbul University-Cerrahpasa Environmental Engineering Department

328 p.

ISBN 978-605-07-0669-7

No subject or language corrections were done on abstracts by editors.
Authors are individually responsible for their papers.

Preface

International Conference on Recycling and Reuse (R&R, 2018) organized by on of the leading universities of Turkiye; Istanbul University-Cerrahpasa, was held in Istanbul, 24-26 October, 2018. The conference brought together engineers, scientists, practitioners and other environmental professionals from many countries all over the world to exchange emerging ideas and to investigate key issues such as: integrated waste management; novel applications for reuse and recycling; renewable energy sources and green technologies. Over 100 oral and poster presentations as well as eight plenary lectures and six invited talks from eminent researchers have been scheduled in an intensive three-day program. Most importantly, over 40 young master and doctoral students participated in the conference. The participation of about 20 young researchers was subsidized by R&R, 2018 organization through fee remission.

The organizers would like to express their thanks to the keynote speakers for their excellent presentations. Special thanks should also be addressed to the members of the Scientific Committee. Moreover, we are very grateful to the members of the Organizing Committee as well as to our Sponsors who made the R&R, 2018 Conference a great success. It is also worth to mention that presented contributions, both oral and posters, could be submitted as full research papers to the journals; *Desalination and Water Treatment, Water Science and Technology, Water Science and Technology: Water Supply, Water Practice and Technology, International Journal of Global Warming* which provided special efforts to publish the selected conference papers. Finally, we thank all participants without whom the R&R, 2018 Conference would not have been possible.

We would like to welcome you at the forthcoming 5th International Conference on Recycling and Reuse (R&R, 2020).

Hoşçakalın,

October 2018, Istanbul

Prof. Dr. Hüseyin Selçuk

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Green Synthesis of Pd/Fe Bimetallic Nanoparticles: Catalytic in situ Generation of H_2O_2 for Heterogeneous Fenton-like Decolourisation of Basic Red 46 and Direct Red 23

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Keywords: Palladium-iron bimetallic nanoparticles, Citrus limon, in situ H_2O_2, Heterogeneous Fenton-like reaction, catalyst, Basic Red 46, Direct Red 23

Abstract

In this study, Pd/Fe bimetallic nanoparticles (Pd/FeNPs) were biosynthesized by aqueous lemon (*Citrus limon (L.) Burm. f.)* leaves extract as a reducing agent and were characterized by XRD, SEM, EDX and FTIR anaysis methods. And then, Pd/FeNPs were utilized as a common heterogeneous catalyst for both in situ H_2O_2 synthesis by formic acid decomposition in the presence of oxygen and heterogeneous Fenton like decolourisation of Basic Red 46 (BR 46) and Direct Red 23 (DR 23) azo dyes.

1. Introduction

In recent years; the wastewater treatment methods are called as Advanced Oxidation Processes (AOPs), icluding homogeneous Fenton reaction (Fe(II)/H_2O_2), photo-Fenton reaction (Fe(II)/H_2O_2/UV), ozonation (O_3), wet peroxide ozonation (O_3 /H_2O_2), H_2O_2/ UV, heterogeneous Fenton-like processes and photocatalytic (TiO_2/UV and ZnO/UV) processes have attracted considerable attention for the removal of toxic and carcinogenic organic/ inorganic pollutants from water sources. Heterogeneous Fenton-like reaction is one of the popular advanced oxidation processes. Hydrogen peroxide (H_2O_2) is the most preferred oxidizing agent because of its environmental friendliness, rapid and easy formation of hydroxyl radicals for degradation of contaminants in heterogeneous Fenton-like reactions. However, the problems such as, the use of hydrogen peroxide is much higher than which is converted into hydroxyl radicals during the reaction due to the hydrogen peroxide is fed to the system in bulk, the cost of commercial hydrogen peroxide is expensive, difficulties in synthesis method, danger of transport and storage, affect the process negatively. Therefore, the indirect synthesis of H_2O_2 catalytically in the reaction medium without adding H_2O_2 from the outside (in situ hydrogen peroxide synthesis) offers an advantage in avoiding problems caused by unnecessary use of H_2O_2, in the heterogeneous Fenton-like reactions. In this method which is called as in situ H_2O_2 synthesis; the catalytic decomposition of the organic compounds such as formic acid, hydrazine hydrate and hydroxyl amine etc., which have substituted hydrogen in their structure and mostly used for hydrogen production, leads to hydrogene gas generation and H_2O_2 can be synthesized by the reaction of hydrogene and oxygen added in reaction media [1, 2].

In this study, Pd/Fe bimetallic nanoparticles will be biosynthesized as a catalyst by aqueous lemon leaves etract as a reducing agent for both in situ H_2O_2 synthesis and the decolorisation of Basic Red 46 (BR 46) and Direct Red 23 (DR 23) azo dyes with heterogeneous Fenton-like reactions.

2. Materials and Methods

Green Synthesis of Pd/Fe Bimetallic Nanoparticles

The lemon leaves were firstly washed with distilled water and then air-dried at ambient temperature. For the preparation of extract, 10 g of dried leaves were boiled in 500

mL of distilled water in a beaker under continuously stirring for 60 min. For green synthesis of Pd/Fe NPs, 0.5 g of $FeSO_4 \cdot 7H_2O$ and 0.1 g of $PdCl_2$ were dissolved in 60 mL aqueous extract of the lemon leaves at 60 ºC under vigorous stirring. Then, a solution of 1.0 M Na_2CO_3 was added dropwise to the mixture to obtain alkaline pH while changing the color to dark brown. After being stirred again for 3 hours at the same temperature, a suspension was formed which gave precipitate of Pd/FeNPs on centrifugation at 4000 rpm and the obtained nanoparticles were washed with distilled water, respectively, and then dried at 105°C in an oven.

Heterogeneous Fenton like decolourisation experiments with in-situ-generated H_2O_2

In-situ generation of hydrogen peroxide was performed by formic acid decomposition and O_2. Heterogeneous Fenton like decolurisation experiments with in situ H_2O_2 generation were carried out in a 250 mL magnetically stirred three-necked glass balloon. 50 mL of 20 mg/L BR 46 (or DR 23) and 50 mL of 500 mM formic acid were contacted with 1 g/L of catalyst. Initial pH of dye solutions was adjusted to 3.0 by 0.1 N HCl or 0.1 N NaOH solutions. Oxygen/air was passed into the reaction medium with a compressor. Dye concentrations were monitored by sampling at regular time intervals and analyzed by using the UV–vis spectrophotometer at the wavelentgh of 530 and 507 nm for BR 46 and DR 23, respectively. To further verify the in-situ generated H_2O_2, the solution (deionized water instead of dye) during the reaction was filtrated and monitored by spectrophotometric determination using titanium sulfate at 400 nm.

3. Results

The crystalline structure of Pd/FeNPs was confirmed with XRD measurements. According to XRD analysis results, the presence of palladium and iron was confirmed in the structure of Pd/FeNPs. In order to identify the structure of catalyst in detail; SEM, EDX and FT-IR analysis will be also carried out. In this study, in situ H_2O_2 generation was carried out by formic acid decomposition and the formation of H_2O_2 was proved by the UV-vis absorbance spectrum of the resulting yellow complex between H_2O_2 and titanium sulfate at 400 nm. In the heterogeneous Fenton like decolurisation studies with in situ H_2O_2 generation, the decolourisation percentages ≈ 95% for BR 46 and ≈93% for DR 23 were obtained at the conditions of 20 mg/L of initial dye concentration, pH 3.0, 1 g/L of catalyst concentration, 25°C ambient temperature and 500 mM- 50 mL of HCOOH concentration. It was determined that Fe and Pd played important roles in the synergistic effect, that is, Pd nanoparticles worked in in-situ H_2O_2 generation by formic acid decomposition and Fe nanoparticles worked in decompose H_2O_2 for generating $^{\bullet}OH$ radicals to decolourisation of BR 46 and DR 23. Moreover, the adsorbent property of Pd/FeNPs was investigated in the same experimental conditions but the absence of formic acid and H_2O_2. These control experiments showed that, almost no colour removal percentages were found both two dyes. In order to determine the decolourisation efficiency of heterogeneous Fenton-like reaction which was carried out by in situ H_2O_2 synthesis, the effects of reaction parameters such as, the concentration of formic acid, initial pH of dye solutions, initial dye concentrations and catalyst concentration will be also investigated experimentally in detail. Consequently, the synthesized catalyst displayed excellent performances for BR 46 and DR 23 removal by in-situ generation of hydrogen peroxide and heterogeneous Fenton-like catalytic reaction.

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