論文 / 著書情報
Article / Book Information

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Title(English)	PHOTOCATALYTIC MEMBRANE INTEGRATING Zr-BASED METAL ORGANIC FRAMEWORK AND GRAPHENE OXIDE FOR WATER TREATMENT
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Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

系・コース： Department of, Graduate major in	Civil and Environmental Engineering 系 コース	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of (Engineering)
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

This research thesis studied on the development of a novel photocatalytic nanofiltration (NF) membrane by modifying the surface of NF membrane with nanocomposite of Zr-based organic framework enhanced by graphene oxide (UiO-66_GO) for water and wastewater treatment. This study also consist of several specific objectives as follows.

First, the specific objective is to present a facile hydrothermal method for preparing UiO-66_GO nanocomposites with different GO loading and characterize their physio-chemical properties. As the result, nanocomposite of UiO-66_GO with different GO loadings (0.1, 0.5, 1, and 5 wt%) was successfully synthesized by one-step hydrothermal method and their physio-chemical properties were confirmed by the analyses of their crystalline structure, surface functional groups, morphology, element compositions, specific surface area, porosity and light absorption.

Second, the specific objective is to investigate the enhancing effect of GO on the photocatalytic activity of UiO-66. Consequently, UiO-66_GO composite has been successfully applied in the photodegradation of the persistent pharmaceutical compound CBZ with an effective degradation efficiency (≥95%) superior to those of its constituent materials: GO (<75%) and UiO-66 (<85%). Also, the photocatalytic rate constant over the UiO-66_GO nanocomposite was about 2.8 and 1.7 times higher than those over pristine GO and UiO-66, respectively. The improvement of the photocatalytic activity of UiO-66 by GO is most likely attributable to the increased SSA and porosity and the narrower band gap.

The third specific objective is to test the photodegradation of CBZ with different GO contents in the composites, catalyst doses and solution pH. The experimental result have indicated that the amount of GO loading, catalyst dose, initial pollutant concentration, and solution pH significantly affect the photodegradation of CBZ by UiO-66_GO nanocomposites and 0.5 wt% of GO loading and acidic pH (pH=5) were optimum condition and were selected for study in the further chapter due to their high photodegradation.

Moreover, another objective in this study is to introduce the pressure-assisted self-assembly (PASA) method to fabricate UiO-66_GO/NF membranes and confirm the membrane stability with different loadings of UiO-66_GO nanocomposite. The result showed that the nanocomposite of UiO-66_GO-5 wt% with different loading (5, 10, 15 wt%) was successfully layered on commercial nanofiltration (Synder NFX) membrane by pressure-assisted self-assembly (PASA) method with a good adhesion of UiO-66_GO composite on NF membrane to fabricate a novel composite membrane.

To evaluate the effect of Ui066_GO nanocomposite on water flux improvement of commercial NF membranes, check stability of the composite membranes after five-time washes and point out the optimum loading of Ui066_GO composite on NF membrane are also other sub-objective in this study. The results confirmed that the presence of UiO-66_GO composite with different loadings (5, 10, 15%) significantly increase the water flux of NF membrane flux to 130, 168, 187 %, respectively due to the enhancement of hydrophilic surface of the membrane. UiO-66_GO composite loading 10 wt% is pointed out as the optimum loading because of its high-water flux improvement (168 %) and good adhesion on NF membrane surface after five-time washes.

In addition, the investigation of the effect of Ui066_GO nanocomposite on FRR and anti-fouling properties indicated that the UiO-66_GO/NF-10% membrane also showed higher FRR (80%) and lower Rir (20%) than did the pristine NF membrane. Hence, Ui066_GO nanocomposite can improve FRR and anti-fouling properties of NF membrane, which were attributed to the increased hydrophilicity, surface smoothness, and charge repulsion.

Furthermore, the determination of the rejection of various OMP groups with different physio-chemical properties by Ui066_GO/ NF membranes demonstrated that adsorption of OMPs on membrane can remove all selected OMPs including ATZ, CBZ, DCF and SMX more than 85%. But when the composite membrane reaches equilibrium state, the steady-state rejections are summarized as: DCF > ATZ > CBZ > SMX which corresponding

their superior hydrophobicity (Logkow): DCF > ATZ > CBZ > SMX (R=0.96), indicating that the hydrophobicity of solute plays important role in rejection by UiO-66_GO-0.5/NF (10%) membrane.
Finally, the examination of the effects of photocatalysis on regeneration of Ui066_GO/NF membranes in order to degrade irreversible foulant and improve flux recovery was concluded that the composite membrane has photocatalytic activity to degrade HA which adsorption on membrane surface and pore by decreasing irreversible fouling from 21 to 7 % and increasing flux recovery ratio from 79 to 93 %.
In conclusion, this novel composite NF (UiO-66_GO-0.5/NF) membrane are expected to produce a high-water capacity, good water quality and low energy consumption. After the safety of permeate water has been confirmed, the composite membrane can be applied in water and wastewater treatment plant which use the NF membrane technology and for the point of use (POU) filter unit in household.