

Synthesis of BiPO₄-Zeolite Composites by Hydrothermal Treatment: Structural and Morphological Insights

Kyaw Soe Lin ^{*,**}, Youhei Nomura ^{*,***}, Ayumu Onda ^{****} and Taku Fujiwara ^{*,***}

^{*} GSGES, Kyoto Univ. ^{**} Faculty of Engineering, Mahidol Univ. ^{***} Graduate School of Engineering, Kyoto Univ. ^{****} Research and Education Faculty, Kochi Univ., Japan

1. Background

- BiPO₄ (BPO) activates sulfate anions (SO₄²⁻) under UV irradiation to generate sulfate radicals (SO₄^{•-}), which exhibit longer lifetime and higher oxidation potential than hydroxyl radicals (HO•) [1,2].
- However, efficient SO₄^{•-} oxidation requires the close proximity between SO₄^{•-} and the contaminants in water [3].
- Zeolite selectively adsorbs contaminants in water and provides a porous surface where the contaminants are concentrated.
- BPO-zeolite composites are expected to couple the contaminant adsorption and SO₄^{•-} oxidation at the catalyst interface.

2. Objectives

- Hydrothermally synthesize BPO-zeolite composites.
- Compare structural and morphological characteristics of the composites prepared with different zeolite supports.

3. Materials and Methods

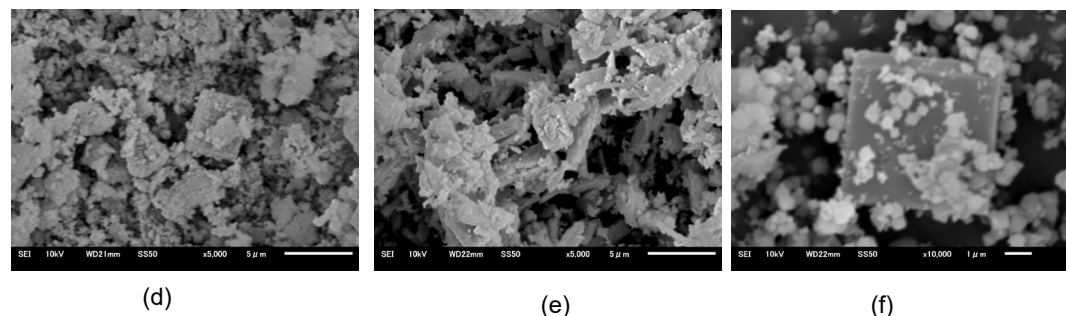
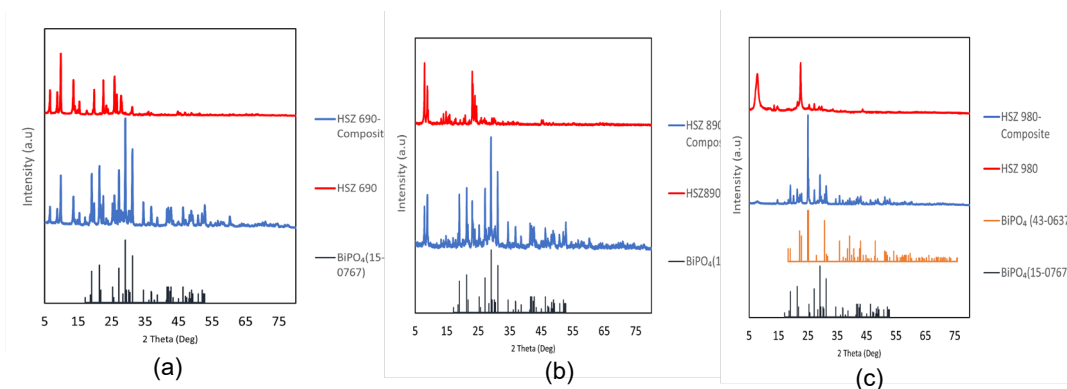
- BPO-Zeolite composites were synthesized as follows:
 1. Add 1.5 mmol Bi(NO₃)₃·6H₂O into 15 mL glycerol–water (1:3 v/v)
 2. Add 1.5mmol Na₃PO₄·12H₂O and stir for 30 min
 3. Add 0.5 g zeolite and stir for 2 h
 4. Hydrothermal treatment at 160°C for 20 h
 5. Wash with DI water and dry at 60°C for 12 h
- XRD analysis was performed to confirm the crystalline phases, and SEM was used to observe the surface morphology.



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4. Results and Discussion

- The XRD patterns of all composites matched the reference patterns (JCPDS 15-0767 and 43-0637) pattern, confirming the formation of monoclinic BPO.
- The adsorption and degradation mechanisms will be explored using the composites to clarify how the zeolite support influences SO₄^{•-} oxidation.



(a–c) XRD patterns and (d–f) SEM images of the BPO-zeolite composites using HSZ-690 (SiO₂/Al₂O₃ 240), HSZ-890 (SiO₂/Al₂O₃ 1500), and HSZ-980 (SiO₂/Al₂O₃ 500), respectively.

[1] Liu G., You S., Tan Y., Ren N. *Environ. Sci. Technol.*, 2017, DOI: 10.1021/acs.est.6b05090.

[2] Li R., Hu Y., Du L., Li J., Yuan J., Liu X. *J. Mol. Struct.*, 2022, DOI: 10.1016/j.molstruc.2022.133547.

[3] Li C., Liu W., Chen X., Li L., Lan S., Zhu M. *Chin. Chem. Lett.*, 2024, DOI: 10.1016/j.ccllet.2024.109652.