Removal of Emulsified Oil by Ferrite-coated Ceramic Membranes

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Supplementary Material

Fig. S1 shows the filtration process in the experiment. Dead end filtering was used in this experiment without the return of the effluent. The artificial emulsified oil wastewater was pumped by peristaltic pump into reactor and another peristaltic pump was used to form a negative pressure inside the ceramic membrane, so that the liquid could pass through the ceramic membrane. Then recorded the flux and took the effluent to the test of emulsified oil concentration.

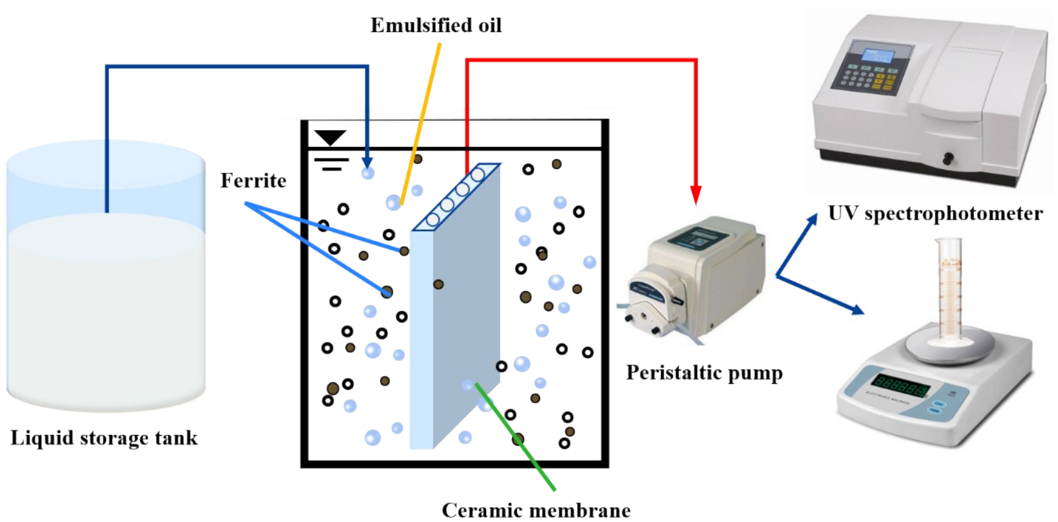

Fig. S2 shows the Co 2p and Fe 2p XPS spectrum of $CoFe_2O_4$ coated ceramic membrane. Two binding energy peaks for Fe $2p_{1/2}$ and Fe $2p_{3/2}$ corresponded to the exist of Fe(III) [1]. The binding energy peaks of Co 2p revealed that Co exists as Co (II) in $CoFe_2O_4$[2].

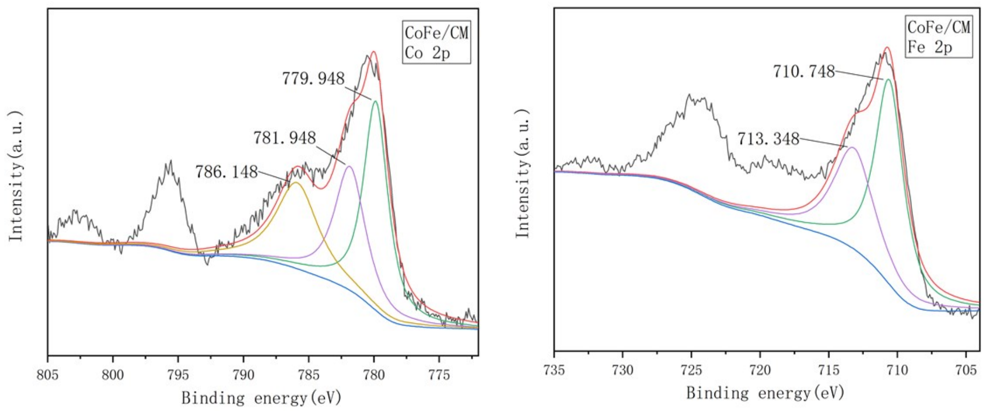

Fig. S2. XPS spectrum of CoFe/CM

Fig. S3 shows the Co 2p, Cu 2p and Fe 2p XPS spectrum of $Co_{0.5}Cu_{0.5}Fe_2O_4$ coated ceramic membrane. Combined with Fig. 2(A), the blank ceramic membrane contained no relevant element of ferrite coated on the ceramic membrane, which shows the successful adhesion of spinel ferrite on the surface of ceramic membrane[3].

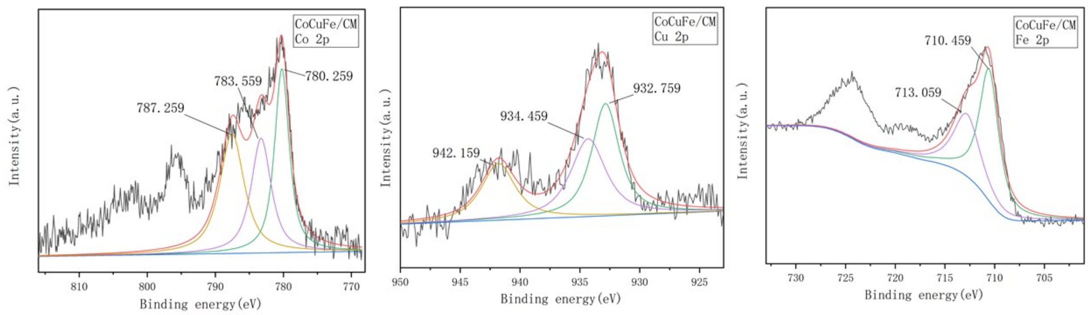

Fig. S3. XPS spectrum of CoCuFe/CM

Fig. S5 and Fig. S6 shows the surface morphologies of the ceramic membrane coated with $CoFe_2O_4$ and $Co_{0.5}Cu_{0.5}Fe_2O_4$. The place where the ceramic membrane particles are connected in the pictures reflected the coating of ferrite.

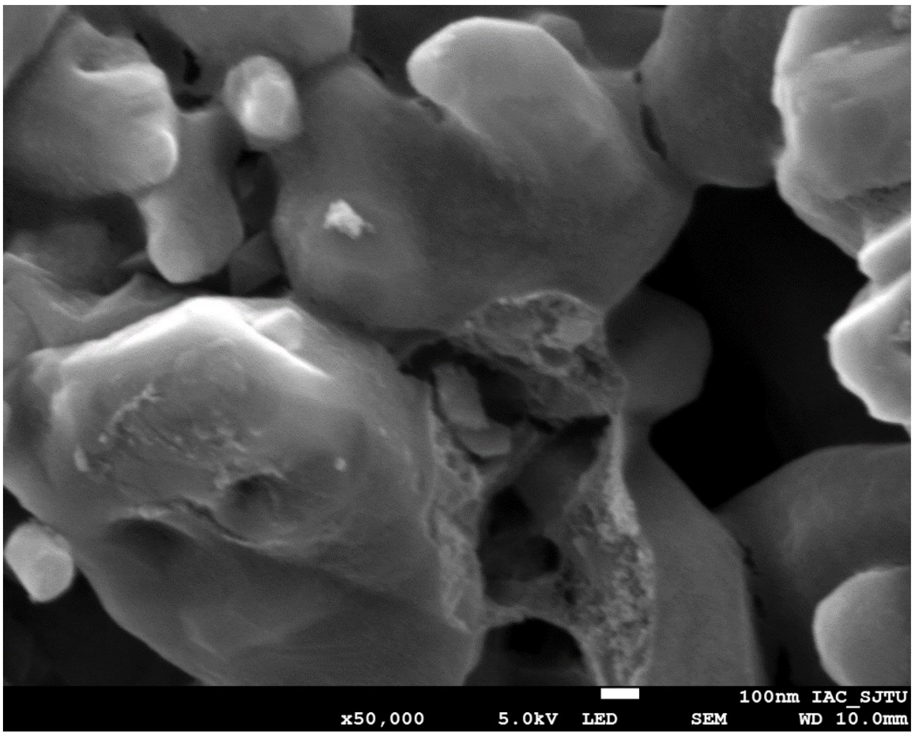

Fig. S5 SEM image of the surface of the CoFe/CM

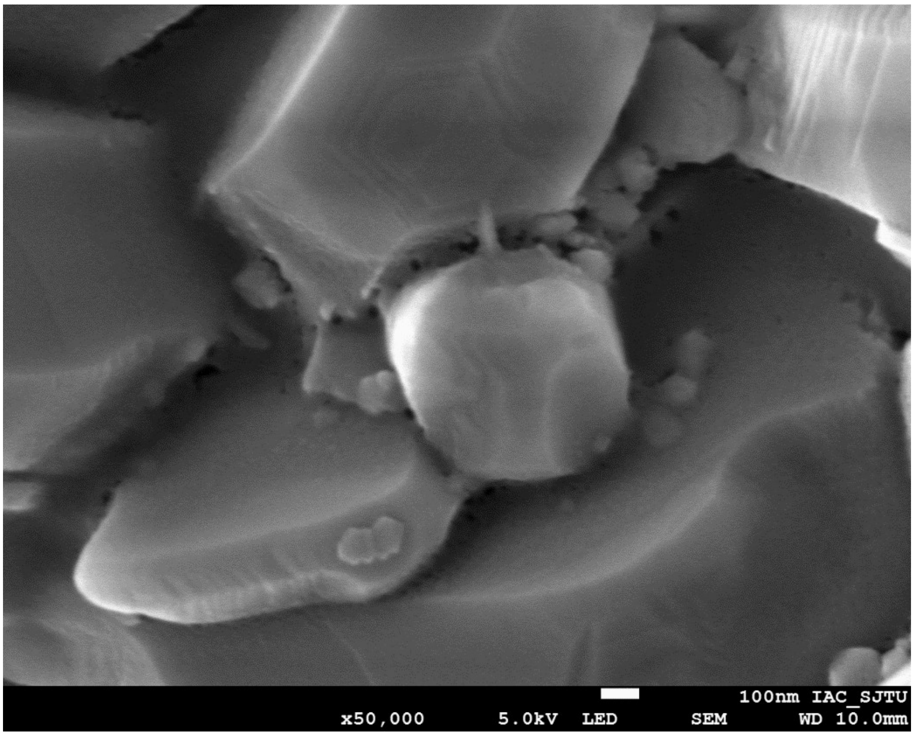

Fig. S6 SEM image of the surface of the CoCuFe/CM

Fig. S7 showed the evolution of membrane permeability of different ceramic membranes under different pH conditions. The membrane permeability of ferrite-coated ceramic membranes was worse than that of the blank ceramic membranes due to the shrinkage of the membrane pores caused by the ferrite coating. However, the ferrite-coated ceramic membranes under the acidic condition with additional H_2O_2 showed a low membrane permeability at the beginning of catalyzing H_2O_2, but the membrane permeability of the ferrite-coated ceramic membranes under the acidic condition was higher than that of the ferrite-coated ceramic membranes under neutral condition later. The result showed that acidic conditions had a positive effect on improving the anti-fouling performance of the ferrite-coated ceramic membranes.

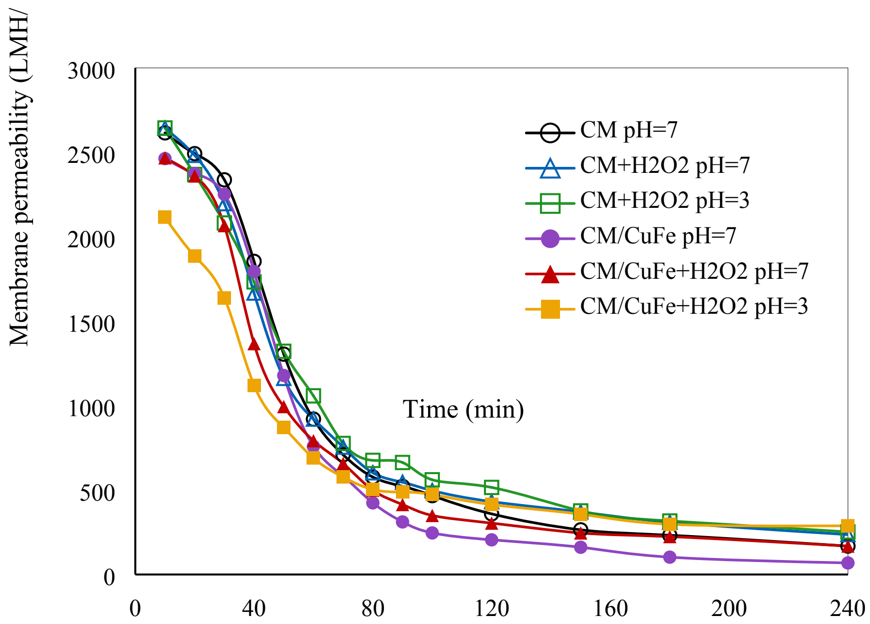

Fig. S7 The evolution of membrane permeability of different ceramic membranes under different pH conditions (The inflow oil concentration :45±5mg/L; pump speed 50rpm; H_2O_2: 15mM; temperature: 25 °C)

Three different kinds of ferrite-coated ceramic membranes were compared and the membrane permeability was in Fig. S8. Under the acidic condition with additional H_2O_2, the initial membrane permeability of the three ferrite-coated ceramic membranes was close to each other and the membrane permeability of CM/Co, CM/Cu and CM/CoCu was lower than that of blank ceramic membranes before 50 minutes. The change of the membrane permeability of the CM/Cu was more stable and the permeability was higher than others after 50 minutes of filtering, representing better anti-pollution performance.

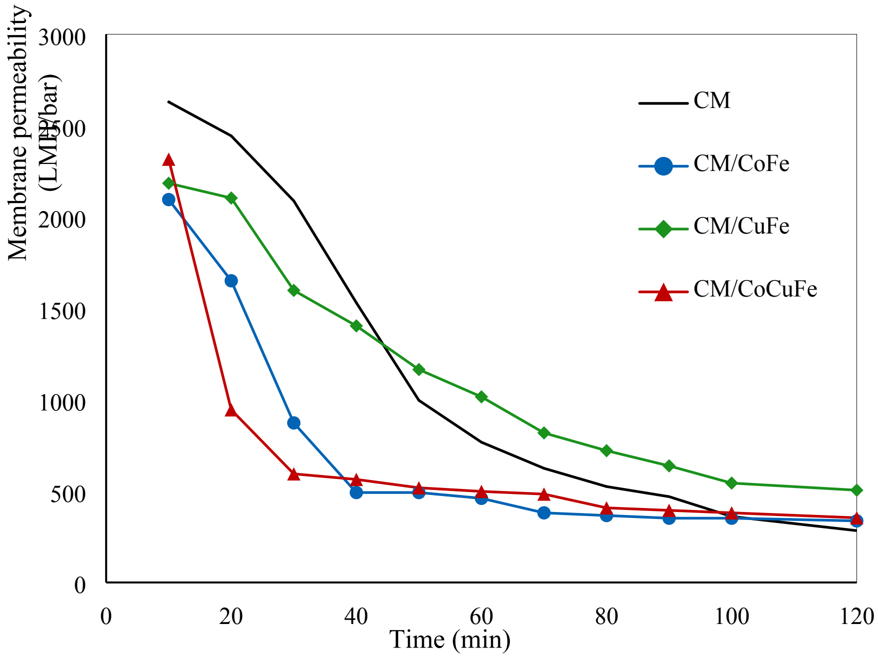

Fig. S8 The evolution of membrane permeability of ceramic membranes coated with different ferrites (B). (The inflow oil concentration: 45±5mg/l; pump speed 50rpm; H_2O_2 concentration: 15mM; pH: 3; temperature: 25 °C).

References

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