Supplementary Material

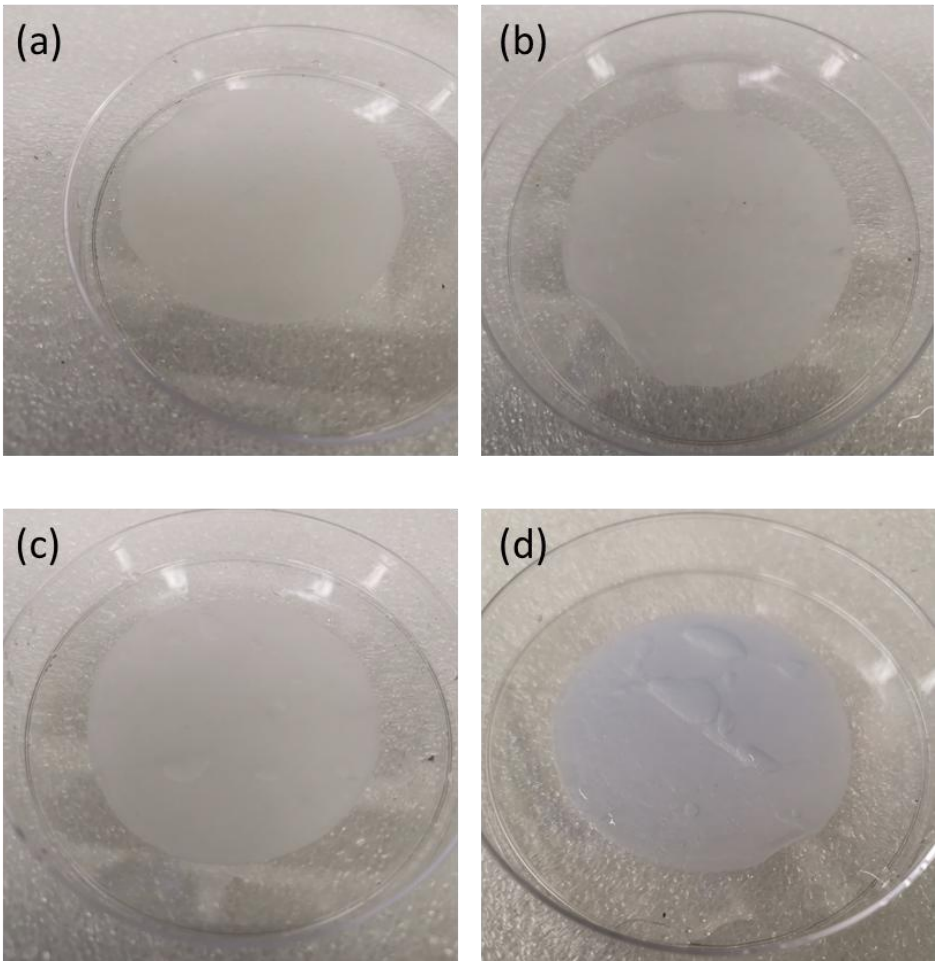

Fig. S1 Photographs of the membranes before and after the adsorption process for cobalt (a)(b) PVDF membrane (c)(d) CAM2.

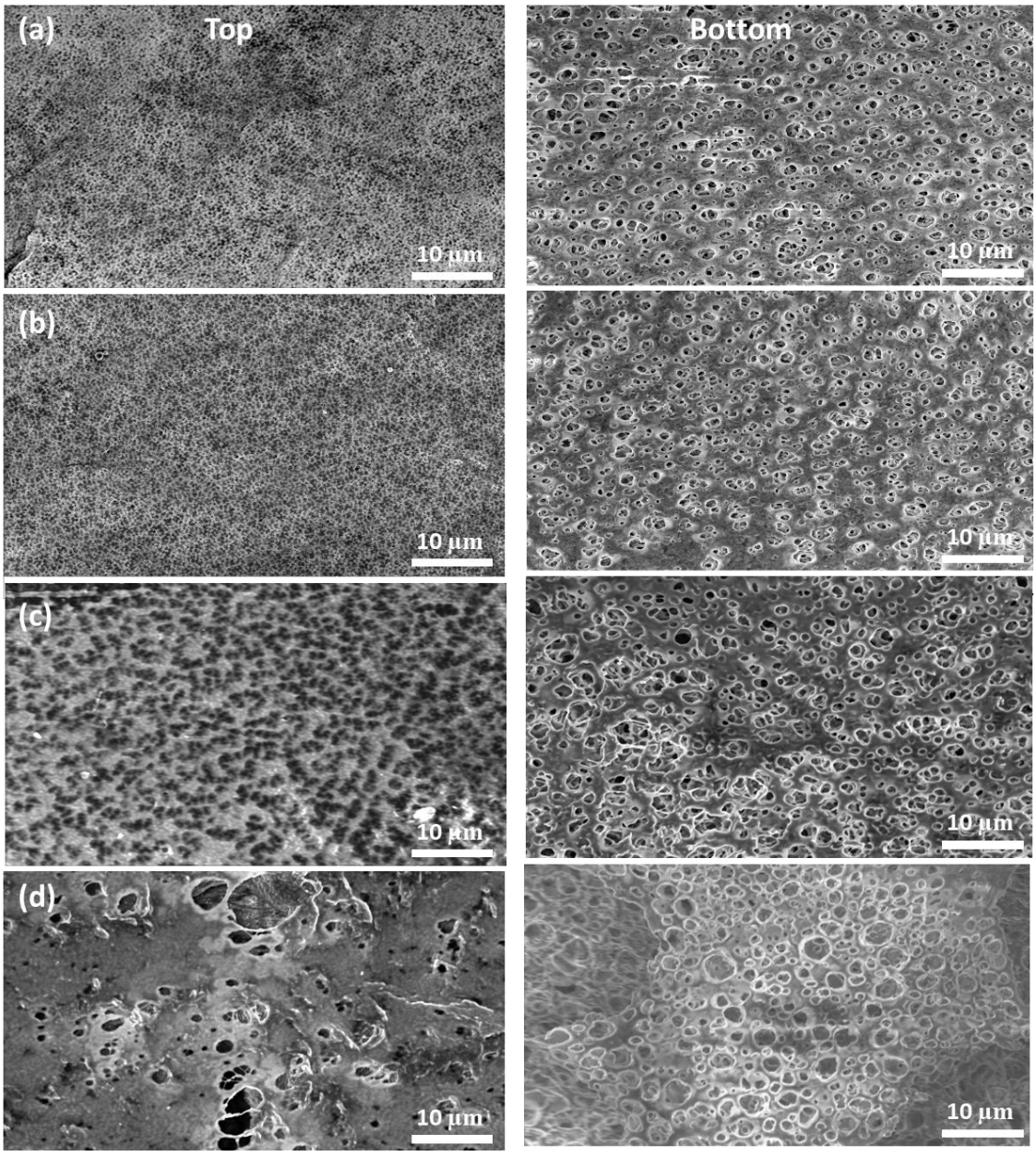

Fig. S2 Top (left) and Bottom (right) Surface under 2k magnification of (a) pristine PVDF membrane (b) CAM1 (c) CAM2 (d) CAM3.

Effect of stripping acid types and concentration

To determine the optimal choice for the stripping process of cobalt ion-loaded membrane, three different stripping solutions were investigated in this study. The loaded membrane was subjected to a stripping test using 0.5 mol/L H_2SO_4, HCL, and EDTA separately, as shown in Fig. S3(b). At this concentration, all three solutions exhibited nearly the same stripping ability for the loaded

membrane. However, 0.5 mol/L H_2SO_4 achieved its highest stripping percentage (99.15%) before 7 min, with HCL and EDTA solutions showing negligible differences, indicating comparable stripping efficiency among the three stripping solutions.

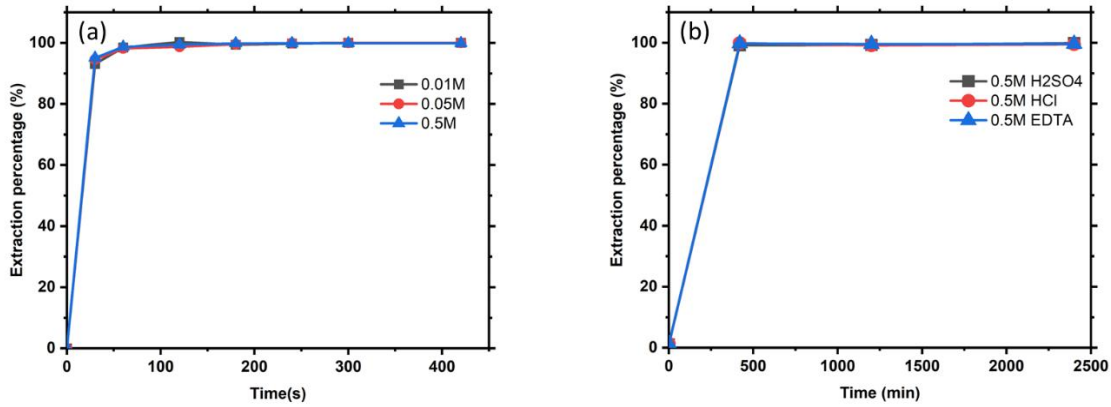

Fig. S3 Cobalt loaded membrane stripped by (a) 0.01 mol/L, 0.05 mol/L and 0.5 mol/L H_2SO_4, (b) 0.5 mol/L H_2SO_4, HCl and EDTA.

As mentioned earlier, since the leaching solution in most industrial processes is a sulfate solution, H_2SO_4 was considered a suitable stripping solution. Therefore, stripping tests were conducted using 0.01 mol/L, 0.05 mol/L, and 0.5 mol/L H_2SO_4 as shown in Fig. S3(a). All three solutions reached their highest stripping capacities within 30 s. The stripping ability of 0.01 mol/L H_2SO_4 was almost equal to that of 0.05 mol/L and 0.5 mol/L H_2SO_4, reaching 91% within the first 30 s and achieving 100% after 90 s. Considering economic utility, 0.01 mol/L H_2SO_4 was the optimal choice for membrane stripping due to its lower acid usage and approximately equal efficiency compared to other types or concentrations of acid, which is consistent with the results of some previous studies (Devi et al., 1998).

References

Devi N, Nathsarma K, Chakravortty V (1998). Separation and recovery of cobalt (II) and nickel (II) from sulphate solutions using sodium salts of D2EHPA, PC 88A and Cyanex 272. Hydrometallurgy, 49(1–2): 47–61