

Synthesis of Zn-Co Bimetallic MOFs on Polymeric Membranes for Selective Direct Lithium Extraction from brines

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INTRODUCTION & AIM

In response to the growing global demand for lithium, traditional extraction methods have proven inefficient and environmentally harmful. As a sustainable alternative, Direct Lithium Extraction (DLE) has emerged, enabling more selective recovery with reduced ecological impact. In this context, Metal–Organic Frameworks (MOFs), known for their high porosity and stability, have become promising materials for modifying membranes used in DLE processes.

METHOD

The synthesis of bimetallic MOFs based on zinc and cobalt was evaluated using 2-methylimidazole as the organic ligand. Membranes were functionalized by systematically varying the Zn:Co molar ratio (1:2, 1:1, 2:1) and the number of deposition cycles to optimize the selective layer. The resulting membranes were characterized using FTIR, SEM, and XRD.

RESULTS

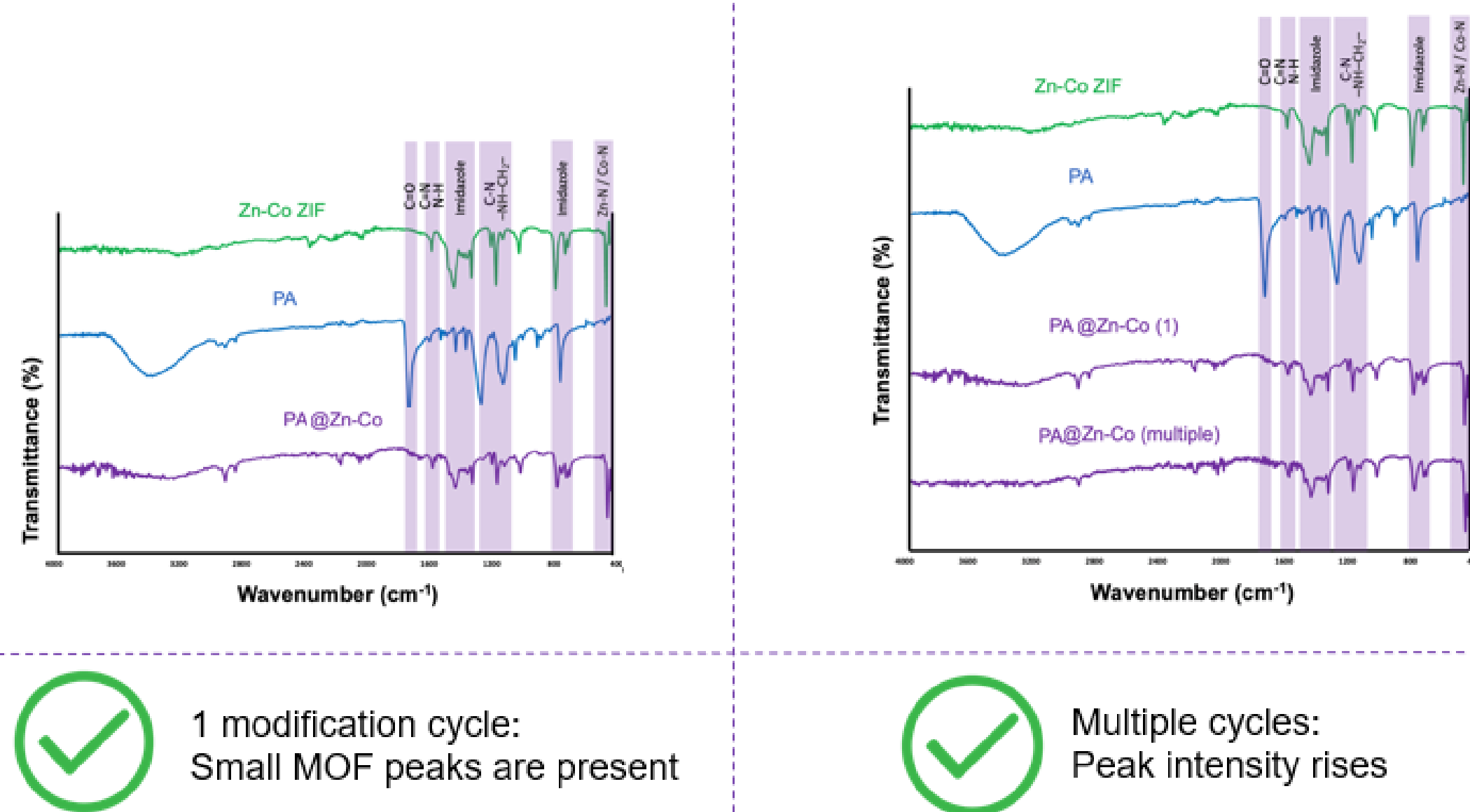


Figure 1. FTIR spectra of Zn-Co ZIF, pristine PA membrane, and PA membranes functionalized with Zn-Co MOFs after one and multiple deposition cycles.

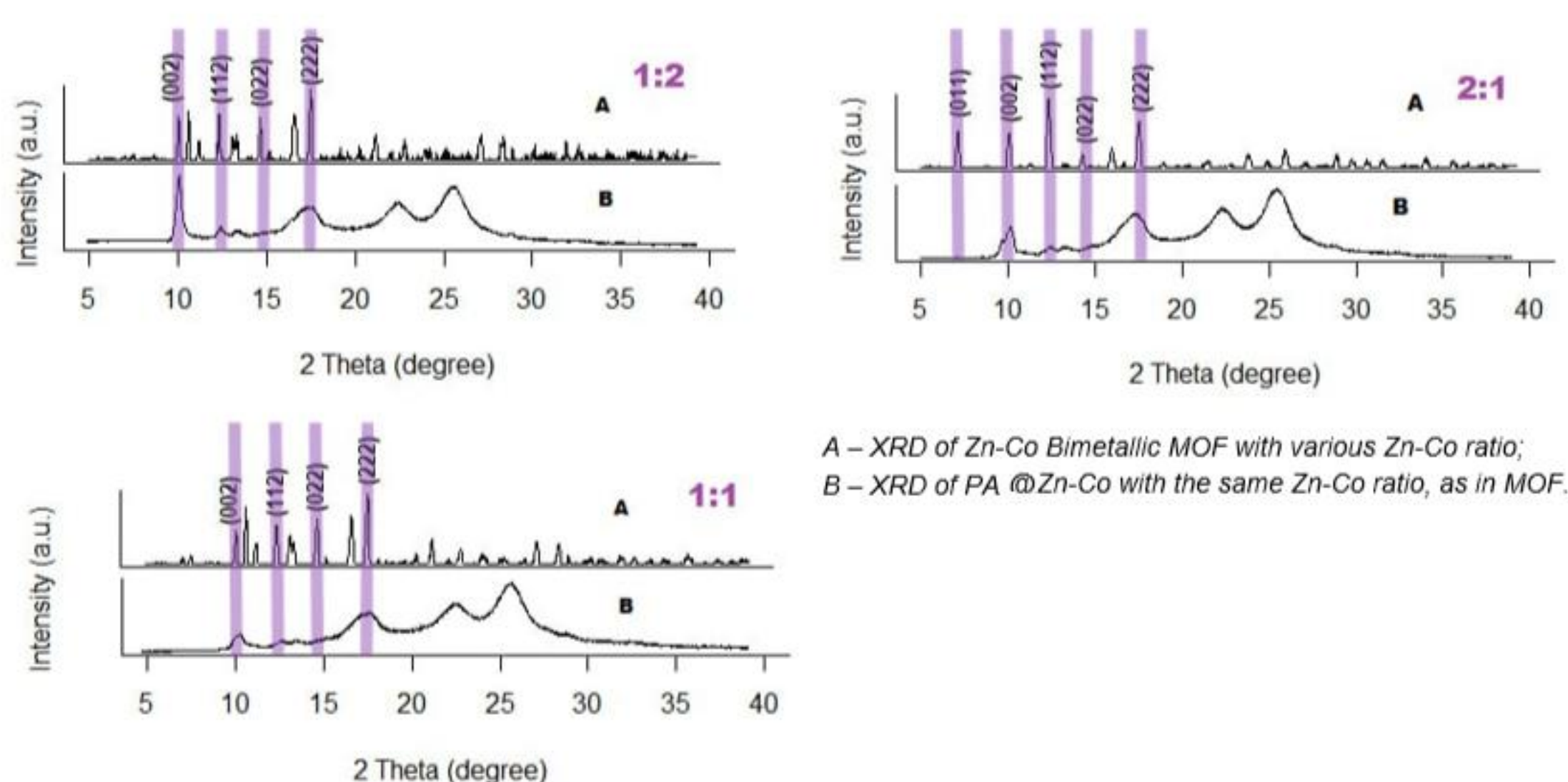


Figure 2. XRD patterns of Zn-Co MOFs and PA membranes functionalized with Zn-Co MOFs, synthesized with different Zn:Co molar ratios (1:2, 1:1, 2:1)

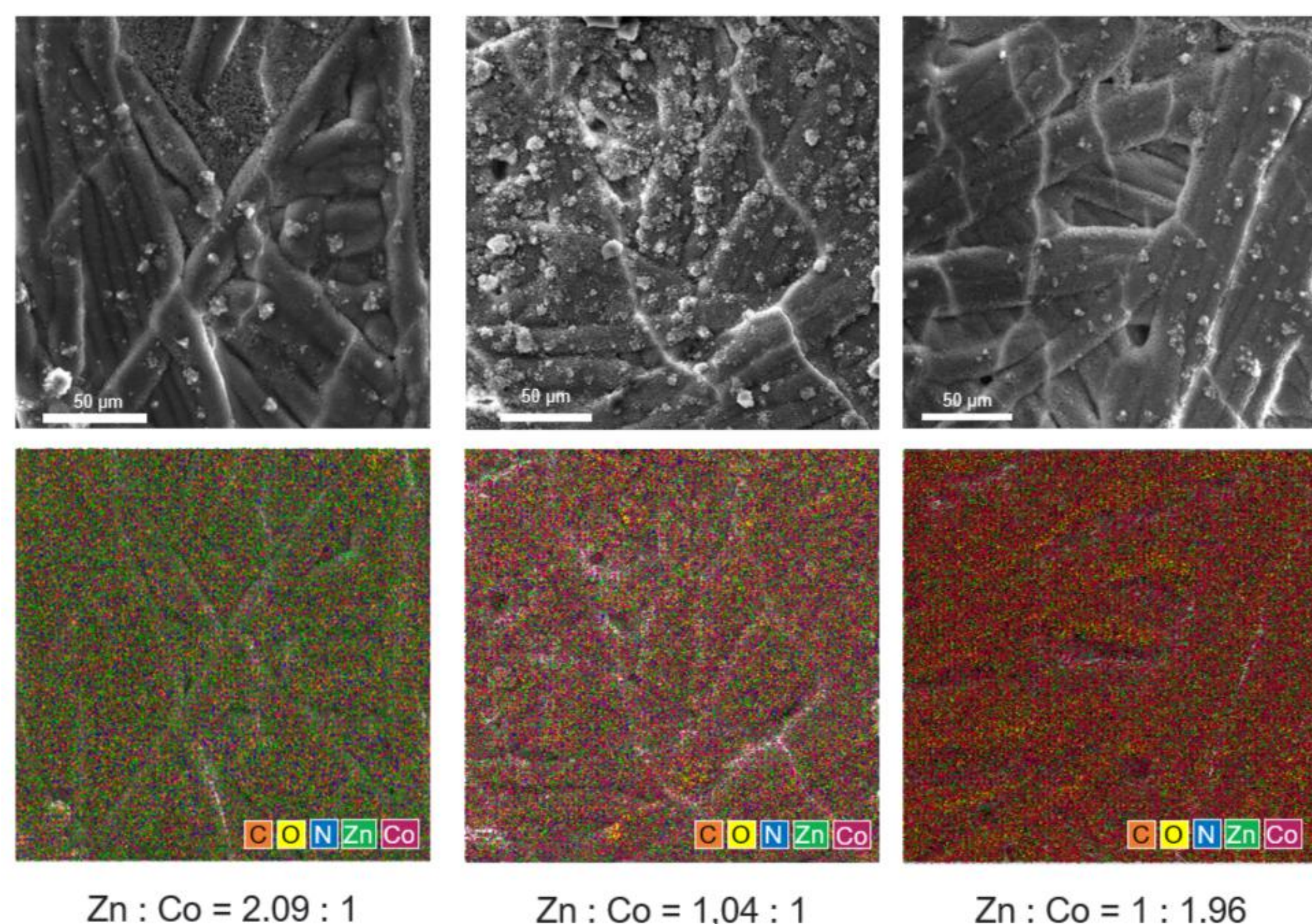


Figure 3. SEM micrographs and EDX elemental mapping of PA membranes functionalized with Zn-Co MOFs at different Zn:Co molar ratios.

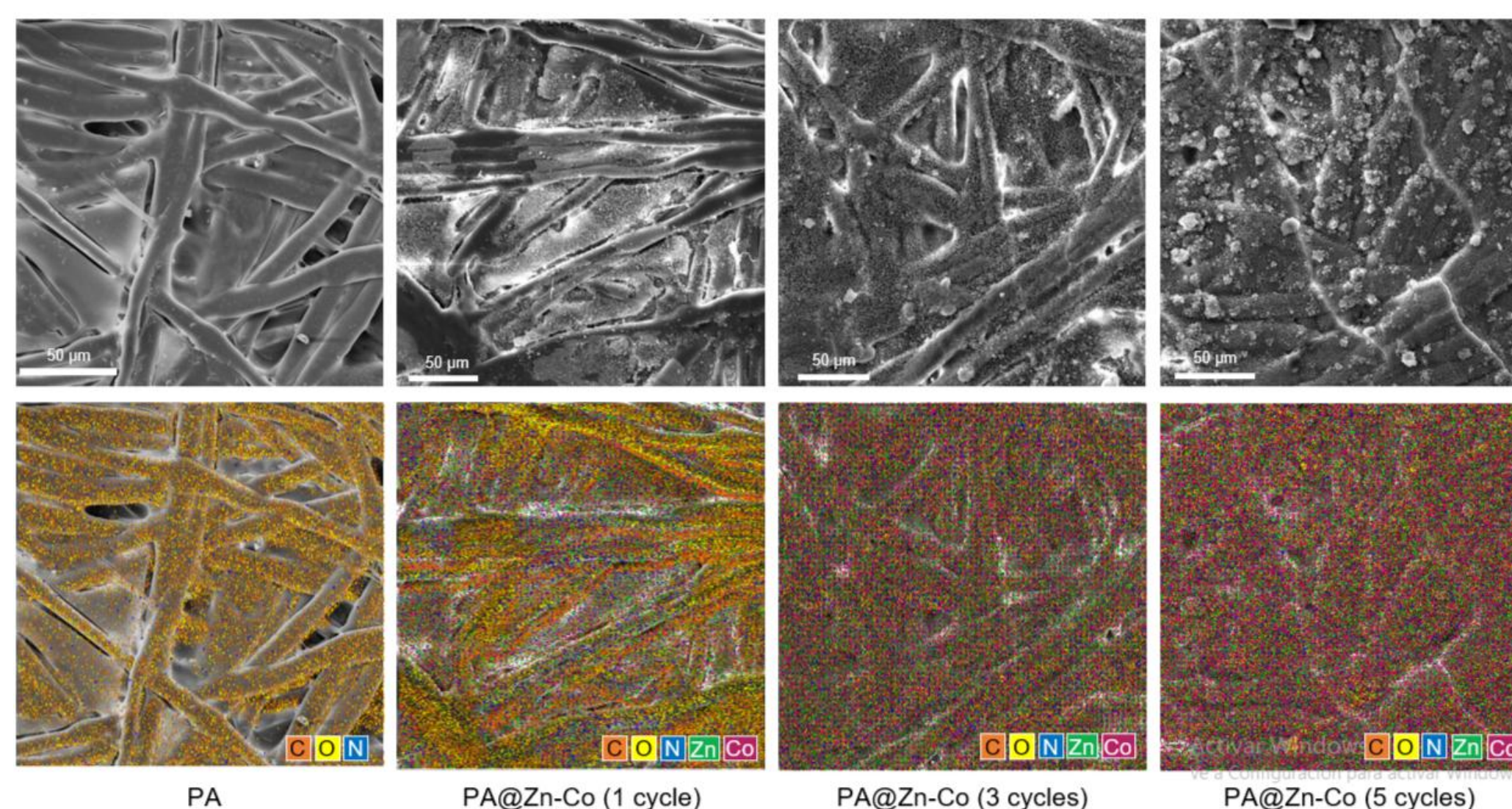


Figure 4. SEM micrographs and EDX elemental mapping of PA membranes functionalized with Zn-Co MOFs after 1, 3, and 5 deposition cycles.

CONCLUSION

FTIR analysis shows that increasing the number of deposition cycles enhances peak intensity, indicating the formation of additional functional groups. Key MOF peaks observed in pure materials were also present in membrane XRD patterns, confirming successful synthesis. SEM and EDX mapping at Zn:Co ratios of 1:1, 1:2, and 2:1 verified accurate metal incorporation. Progressive membrane coverage with MOFs was clearly observed with increasing cycles, confirming the effectiveness of the multi-cycle deposition strategy.

REFERENCES

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