An Entirely New Molecular Glue for MOF Using Unusual Structural Transformation of a Coordination Polymer

ISSF Poster Presentation

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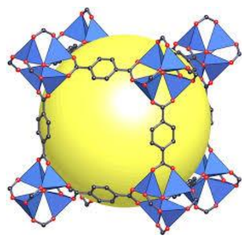
1. Introduction

What is **MOF**?

Metal Cluster + Organic Linker =

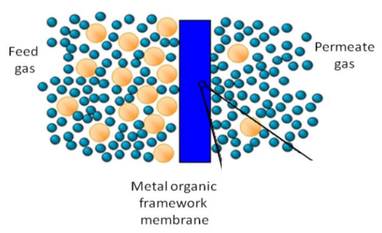


Metal Organic Framework
is a new class of porous material formed by regular coordination of metal ions or metal clusters and organic ligands.

Clean Environment

Fuel Cell / Hydrogen Storage

Carbon Dioxide Capture & Storage



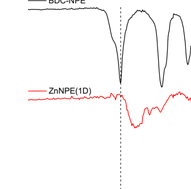
Gas Separation & Filtration

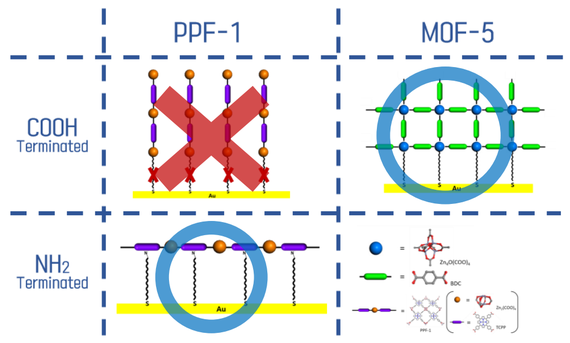
⇨ **Question**. To widen application & usage?

Processable MOF Film Is the **Answer**!

But, limitations of method
- Unique/Processed substrate
- Low thermal stability
- No preformed MOF

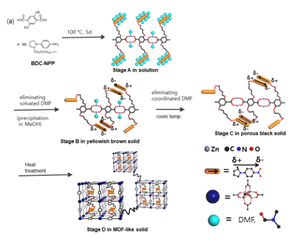
EX) MOF Growth (MOF-5, PPF-1) On SAM (Self-Assembled Monolayer) (R = NH_2, COOH)





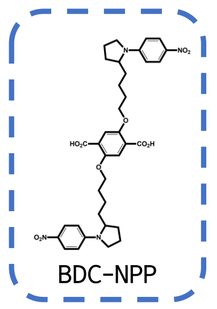
#Idea : Inventing a **Glue!**

Chem. - A Eur. J. **21,** 15570–15574 (2015).



BDC-NPP: Structural transformation from 1D coordination polymer to 3D cross-linked framework takes place[2]

Preceding Research

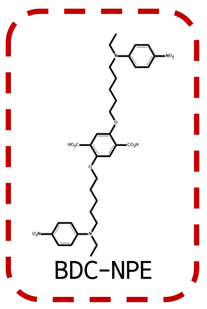


BDC-NPP

〈 Similarity 〉 1D to 3D transformation

〈 Difference 〉 Transformation time decrease

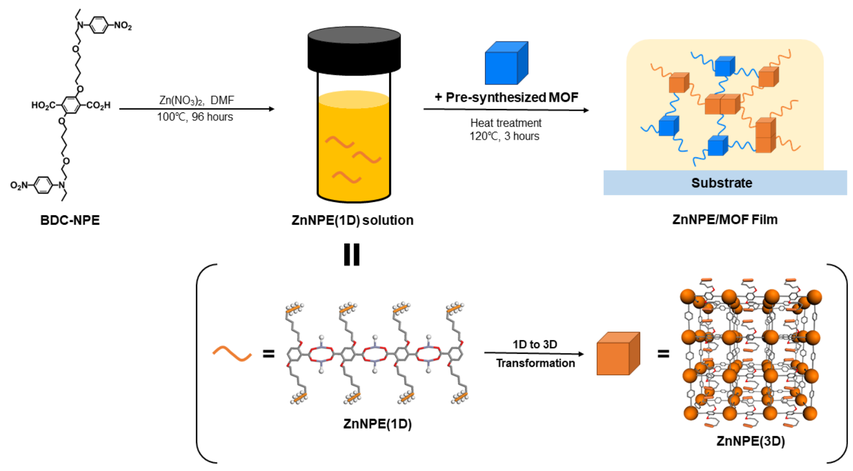
This Research



BDC-NPE

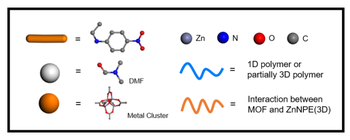
2. Result & Discussion

Synthesis & 1D-3D Transformation



ZnNPE(1D)
Coordination polymer composed of BDC-NPE and zinc metal

ZnNPE(3D)
3D cross-linked framework which transformed from ZnNPE(1D)
⇨ Bind to preformed MOF via interaction between carboxylate functional group

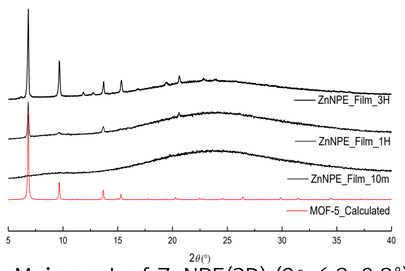


Identification

Infrared Spectroscopy

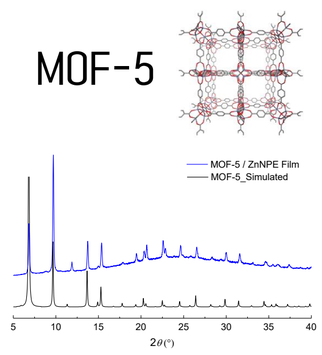
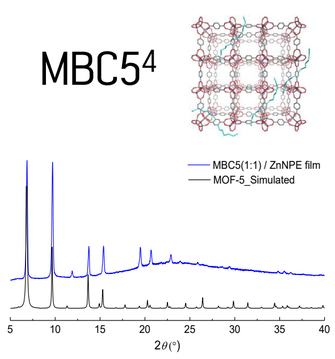
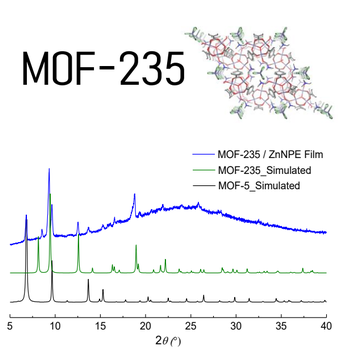
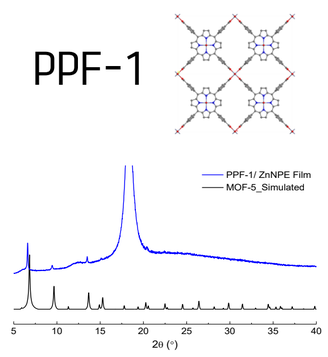
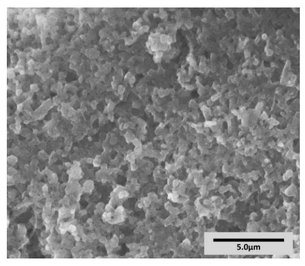
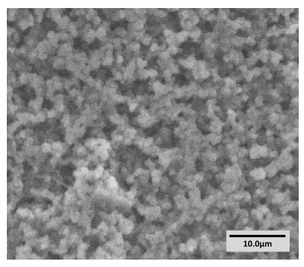
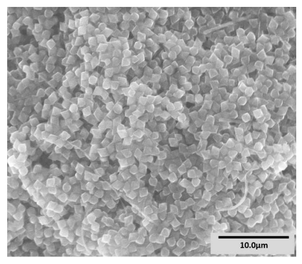
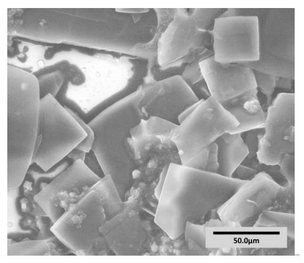
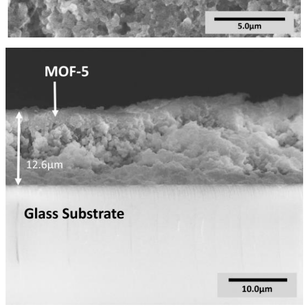
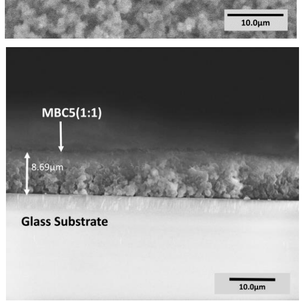
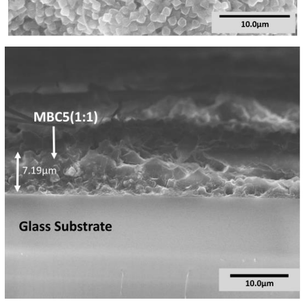
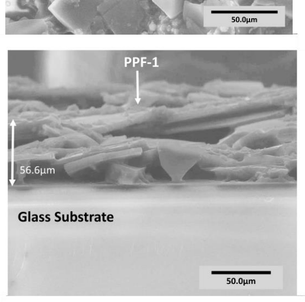
Vibration of COOH molecule (ν=1739cm^{-1},dotted line) disappears on ZnNPE(1D). This confirms synthesis of ZnNPE(1D) polymer[3]

Powder X-Ray Diffraction



Main peak of ZnNPE(3D) (2θ=6.8, 9.8°) is same to that of MOF-5 (2θ=6.8, 9.8°). This confirms ZnNPE(3D)'s topology as a cubic structure, which is same to that of MOF-5

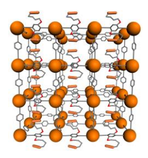
Film Forming Ability

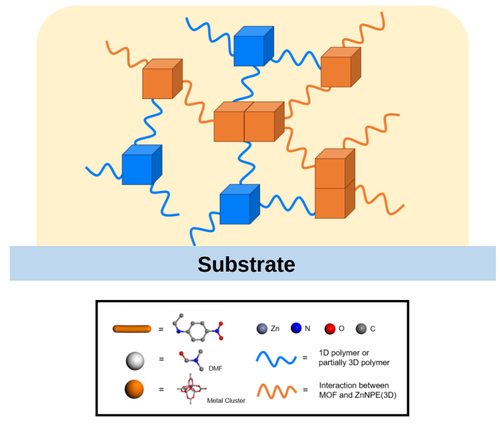
	MOF-5	MBC5[4]	MOF-235	PPF-1
PXRD Graph				
Top View				
Cross-Section View				

Wide range of Preformed MOF can be incorporated

= Any Preformed MOF

= Molecular Glue





3. Conclusion

The conventional fabrication of a MOF typically cannot attach pre-synthesized MOFs and need functionalized substrates. However, using coordination polymer glue to form MOF film, it enables attachment of any preformed MOF to any substrate, which reduces the price of the process and gives high thermal stability. It is the first time to research on a molecular glue which can form MOF films with such an economical and boundless ways, and we expect this molecular glue to greatly expand the application of MOF films. For further research, we must check the capabilities of this MOF film – adsorption, thermal stability – and look for ways to commercialize it.

What We Learned : Through this study, we learned the basics of researching – selecting topic, rearranging our goals through reading various papers, conducting experiments, and summurizing our results. And above all, we realized that collaboration is primarily important in researching and essential to lead good research results.

Reference

[1] O. Shekhah. *et al.* Chem. Soc. Rev., **40**, 2011, 1081–1106.
[2] Lee, S. C. *et al. Chem. – A Eur. J.* **21,** 15570–15574 (2015).
[3] E. Y. Choi *et al.* Chem. Commun. 2009, 7563–7565
[4] Jung, J.-Y. *et al. Macromol. Res.,* **25(11)**, *1100-1104* (2017)

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