Rapid synthesis of MOF-5 via microwave radiation

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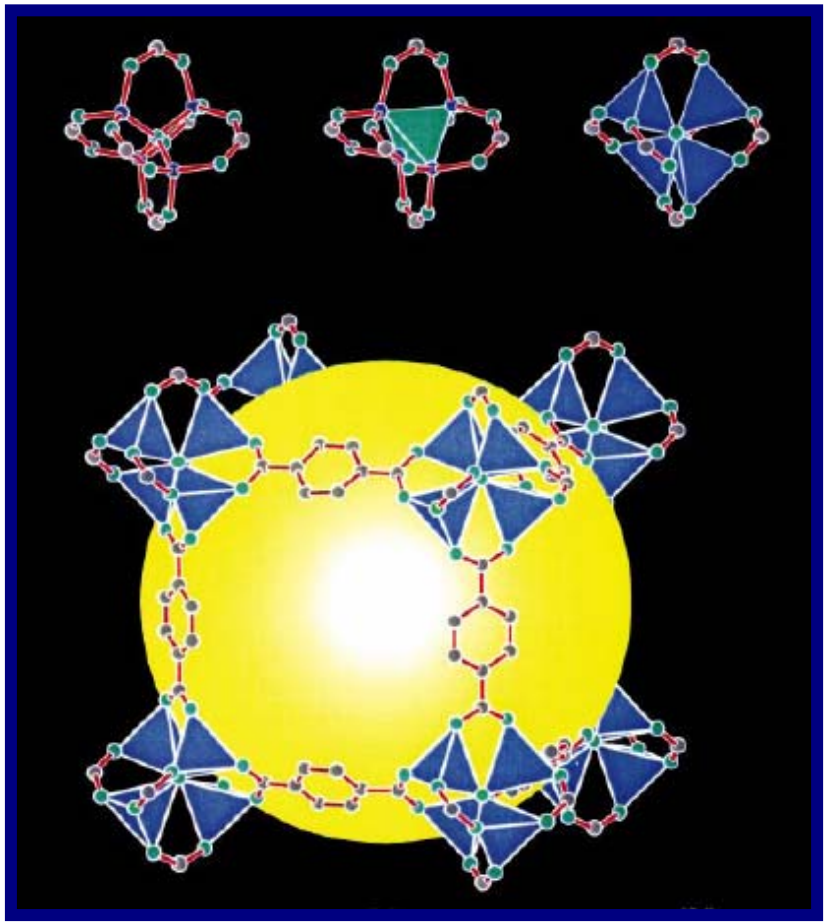
MOF (Metal Organic Framework)

What is MOF(Metal Organic Framework)?



대표적 **MOF**인 **MOF-5** $[Zn_4(O)O_{12}C_6]$

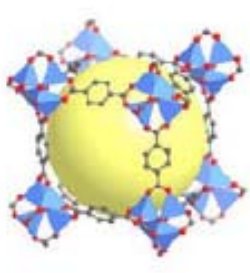
- 전이금속 이온이나 클러스터를 구조물의 꼭지로 하여 이들을 배위결합이 가능한 다양한 유기 리간드로 연결하여 놓은 구조체.
- 다공성 화합물로 작용 가능. 현존하는 가장 비표면적이 큰 물질 중 하나.

  (S_A > 5,000 m^2/g 가능.)
- 다양한 유기 리간드와 금속 이온의 사용으로 기공의 구조와 화학적 물성 조절가능.

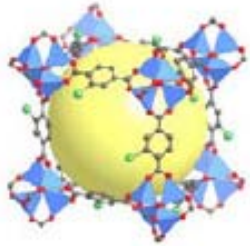
MOF (Metal Organic Framework)

- **Isoreticular Metal-Organic Frameworks (IRMOFs)**

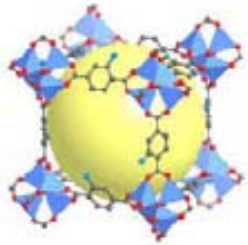
  a series of materials having the same underlying topology and (typically) constructed from the same secondary building units



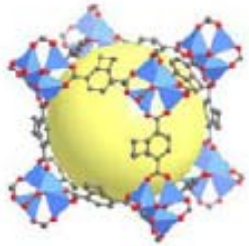
IRMOF-1



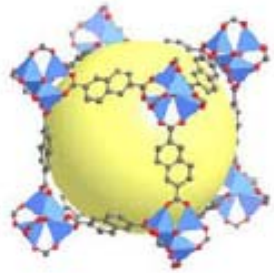
IRMOF-2



IRMOF-3



IRMOF-6



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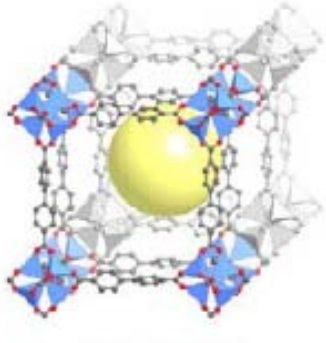

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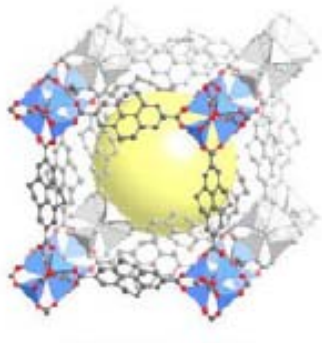

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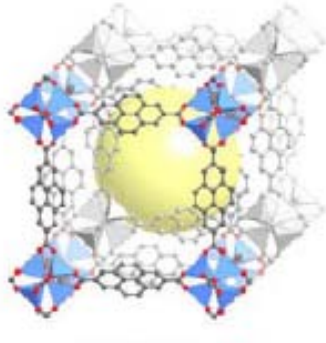
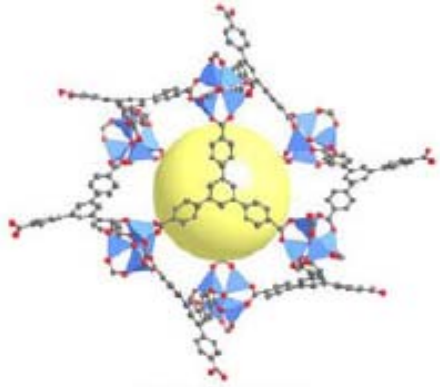


IRMOF-13

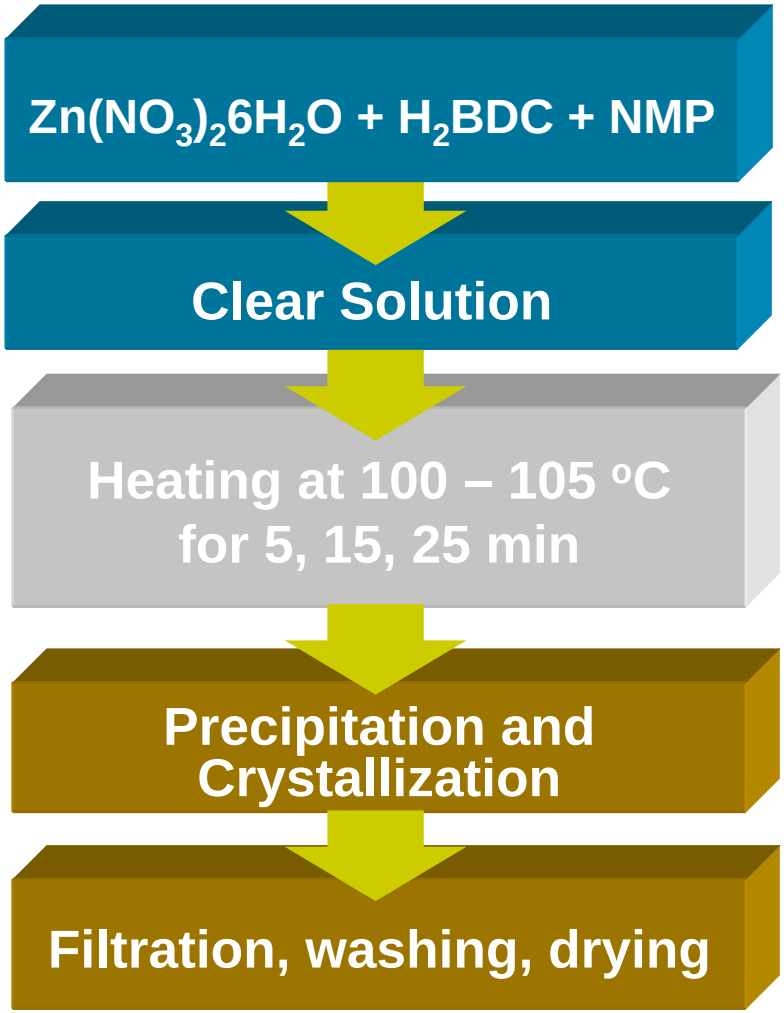


MOF-177

M. Eddaoudi, J. Kim, N. Rosi, D. Vodak, J. Wachter, M. O'Keeffe, O.M. Yaghi, *Science,* **2002,***295*, 469.
H. K. Chae, D. Y. Siberio-Perez, J. Kim, Y-B. Go, M. Eddaoudi, A. J. Matzger, M. O'Keeffe, O.M. Yaghi, *Nature*, **2004**, *427*, 523.

EXPERIMENTAL

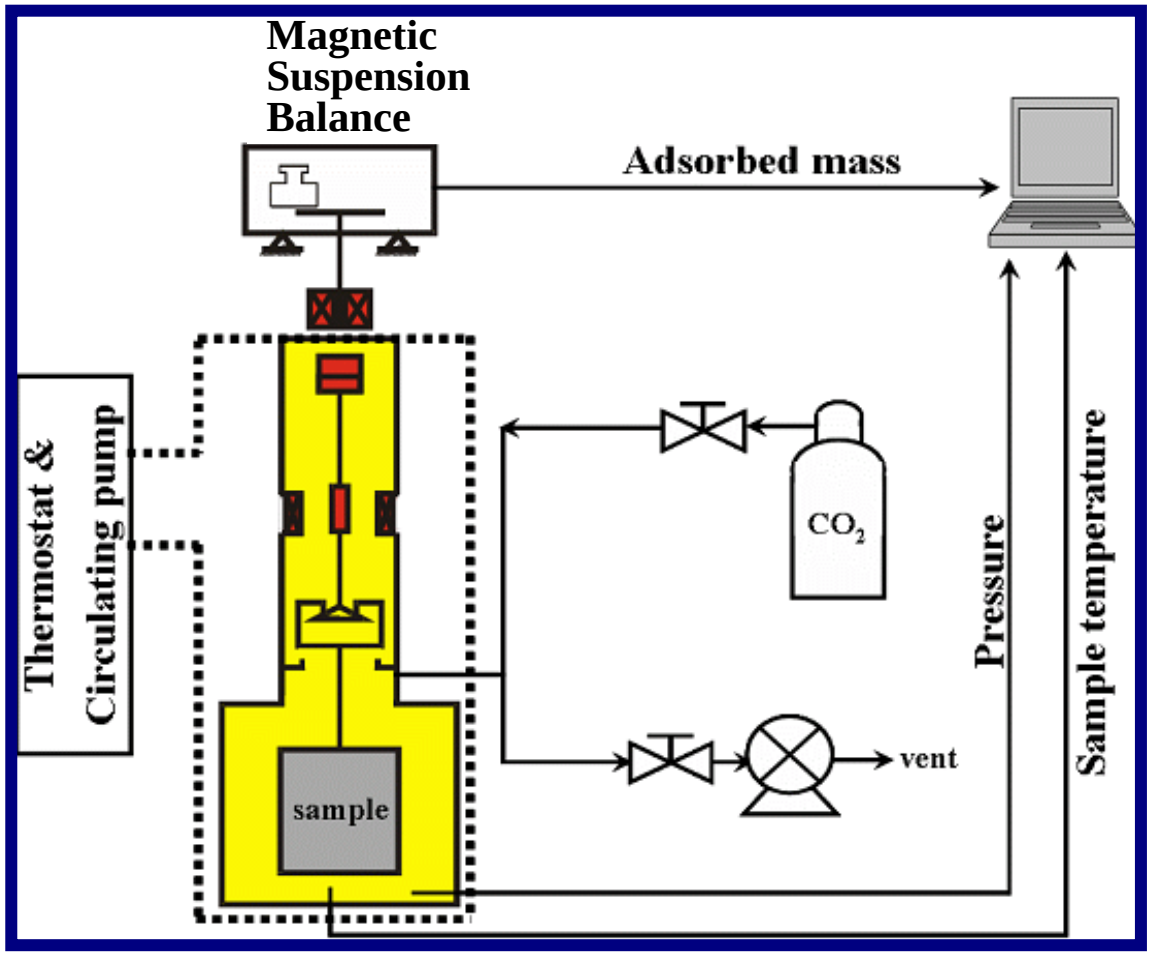
- **Synthesis flow sheet**



Microwave synthetic system

Equipment

- **CO_2 흡착/저장 성능의 정량화 : gravimetric analysis**

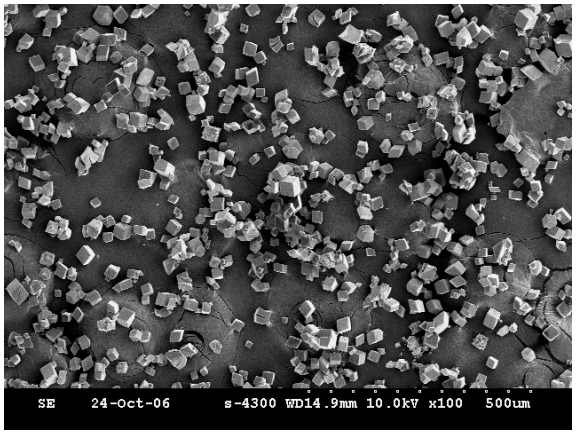
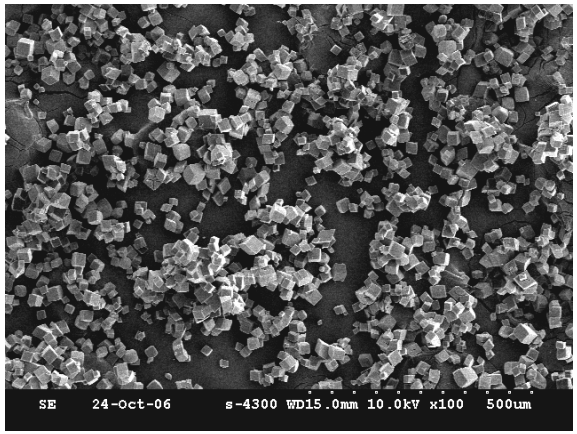
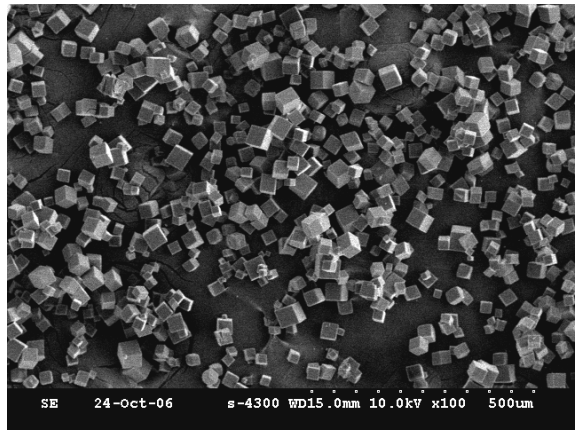
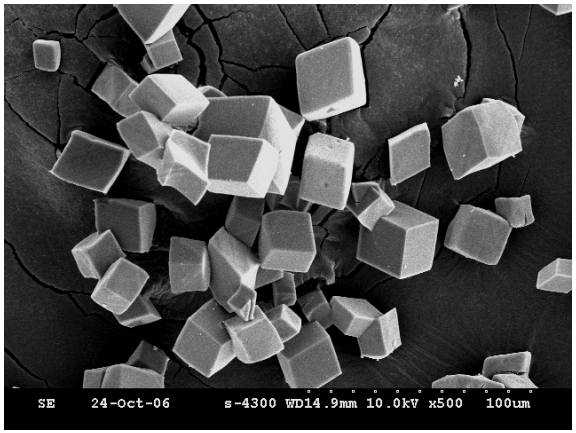
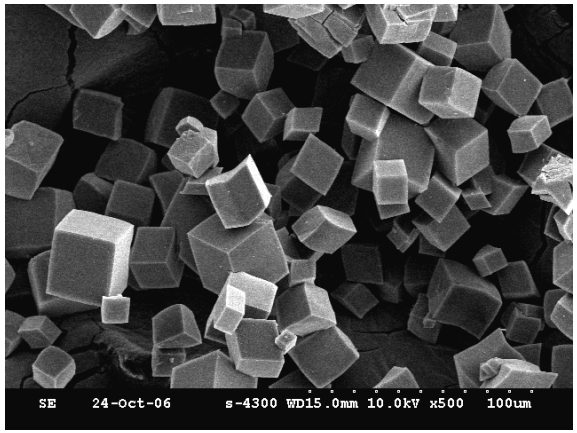
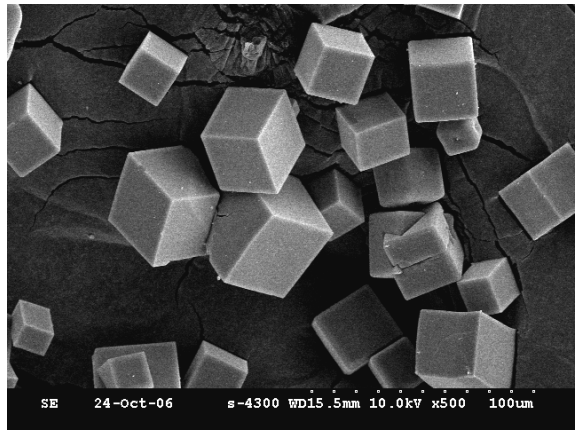


- 흡착등온선 **(1-40** 기압 **,** 상온**)**
- 흡탈착 재생성 **(Pressure Swing sorption).**
- **TGA** 기능을 이용한 흡착제의 재생성 분석 **(Temperature Swing Analysis).**
- 흡**/**탈착 속도 측정**.**

Rubotherm
Magnetic Suspension Balance
- Resolution : 10^{-5} g
- Max. Weight : 80 g

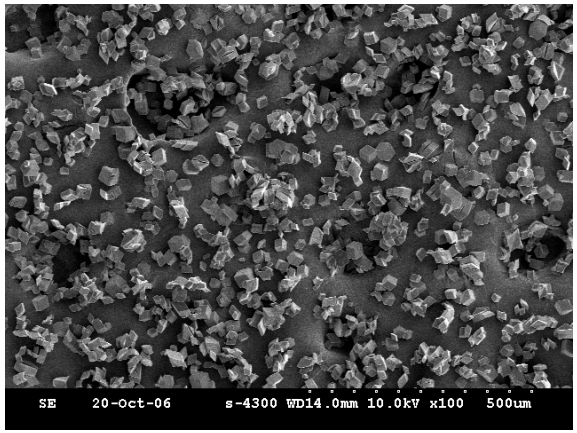
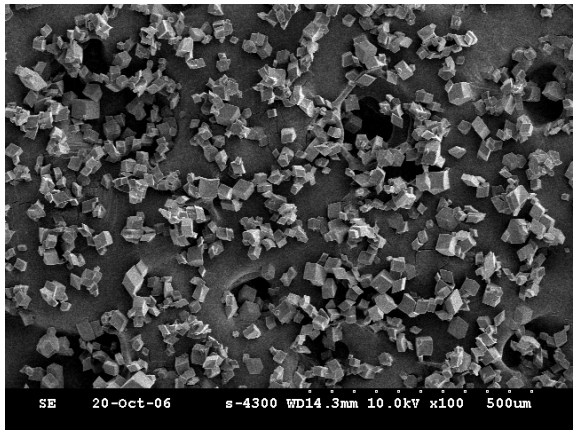
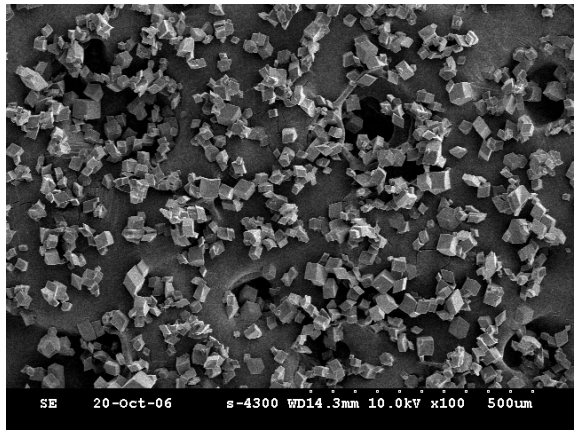
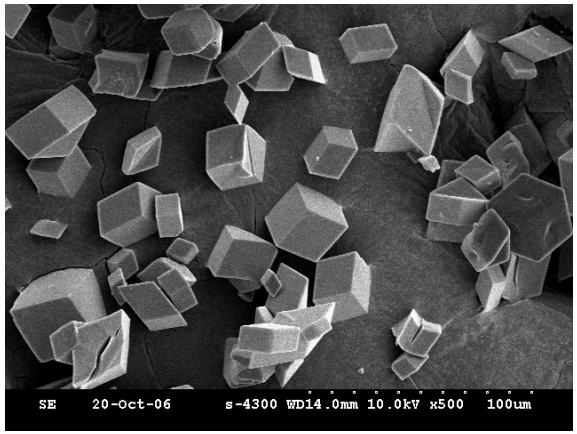
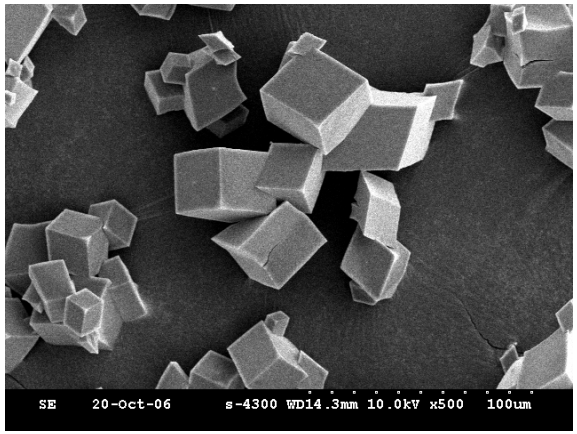
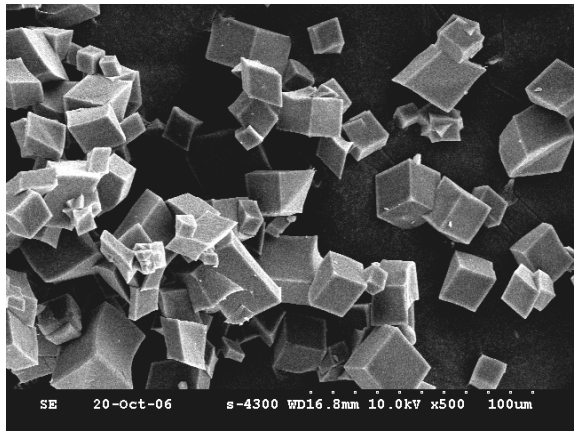
RESULTS & DISCUSSION

- **Scanning Electron Microscope image**

Power 25%, 5 min	Power 25%, 15 min	Power 25%, 25 min
		
		

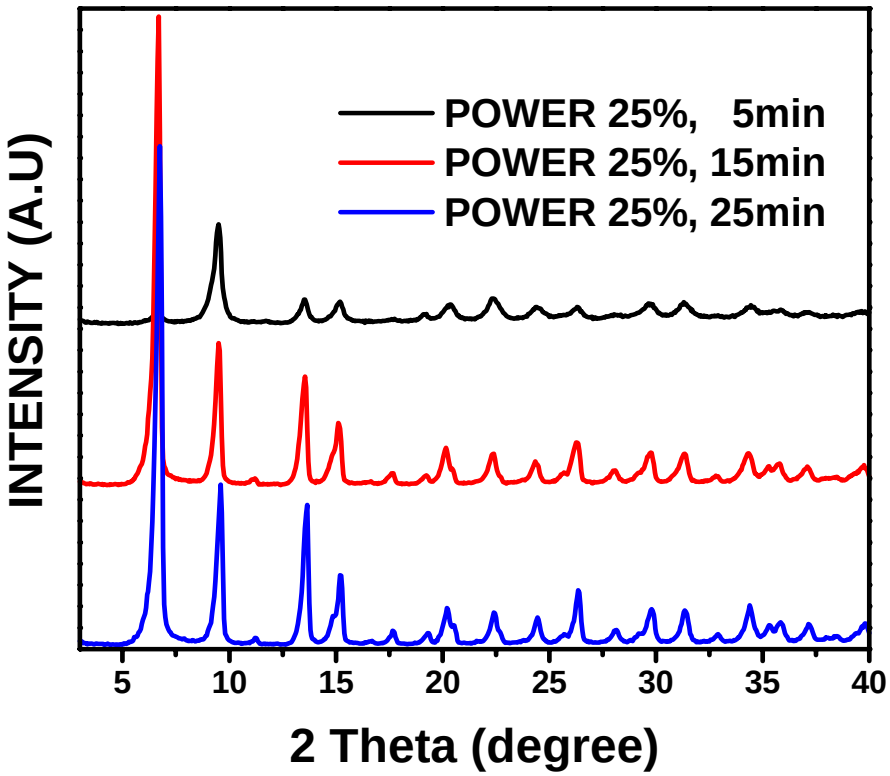
RESULTS & DISCUSSION

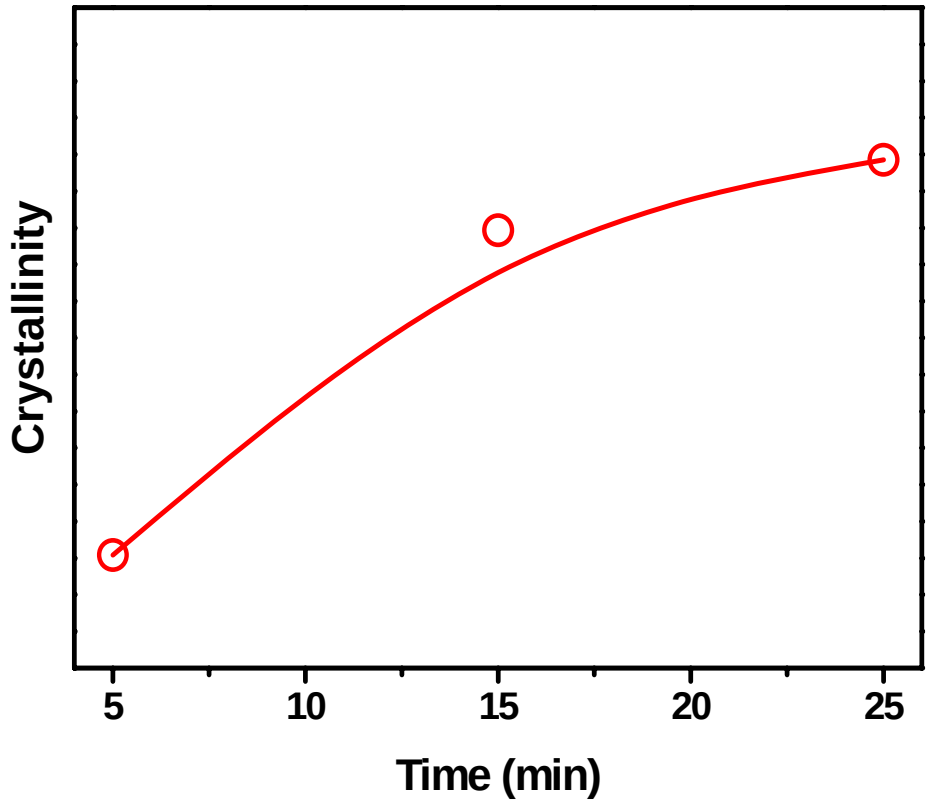
- **Scanning Electron Microscope image**

Power 75%, 5 min	Power 75%, 15 min	Power 75%, 25 min
		
		

RESULTS & DISCUSSION

- **X-Ray diffraction patterns**





RESULTS & DISCUSSION

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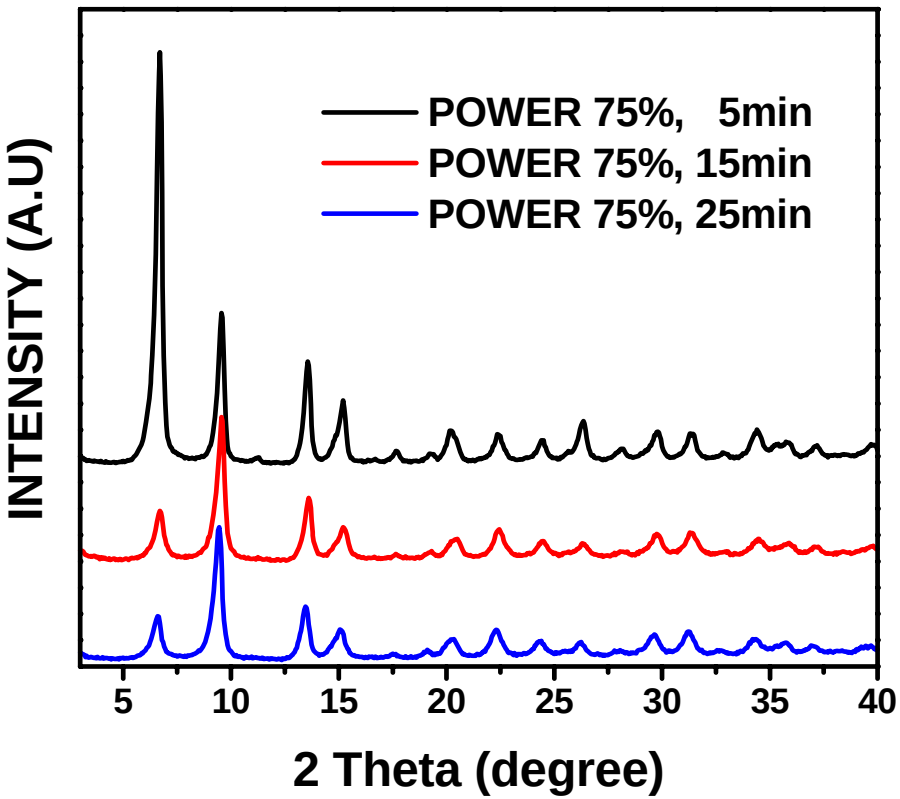
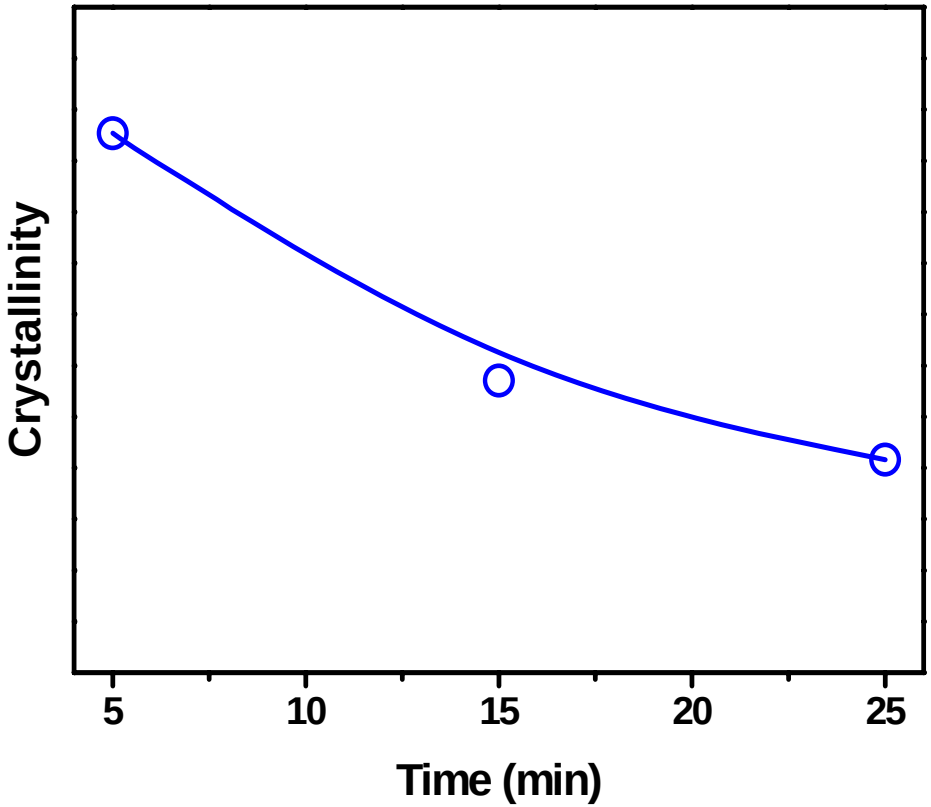
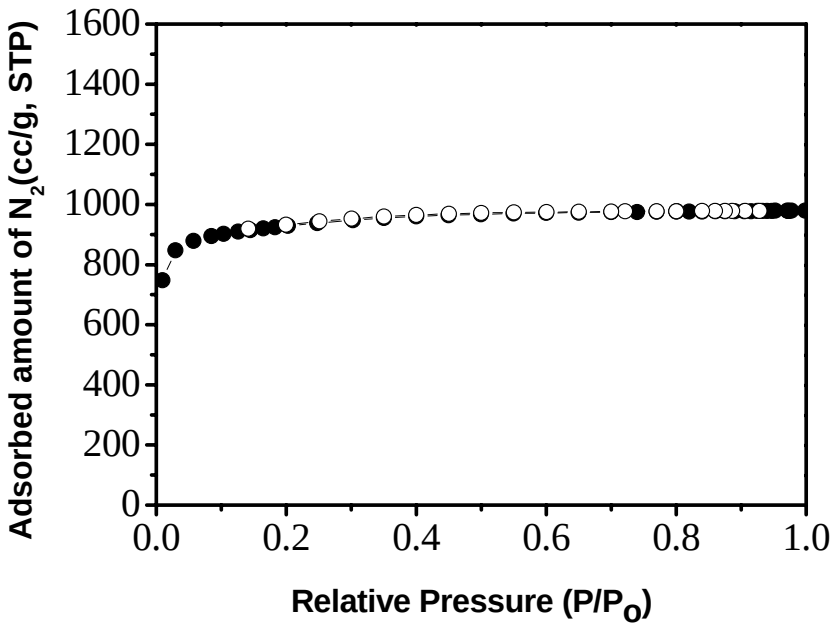


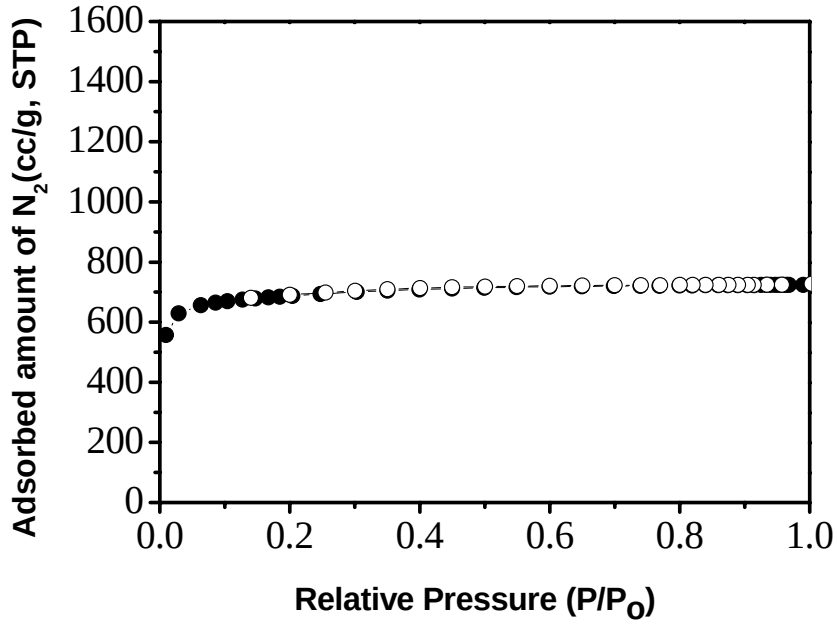


RESULTS & DISCUSSION

Nitrogen Ad/Desorption analysis



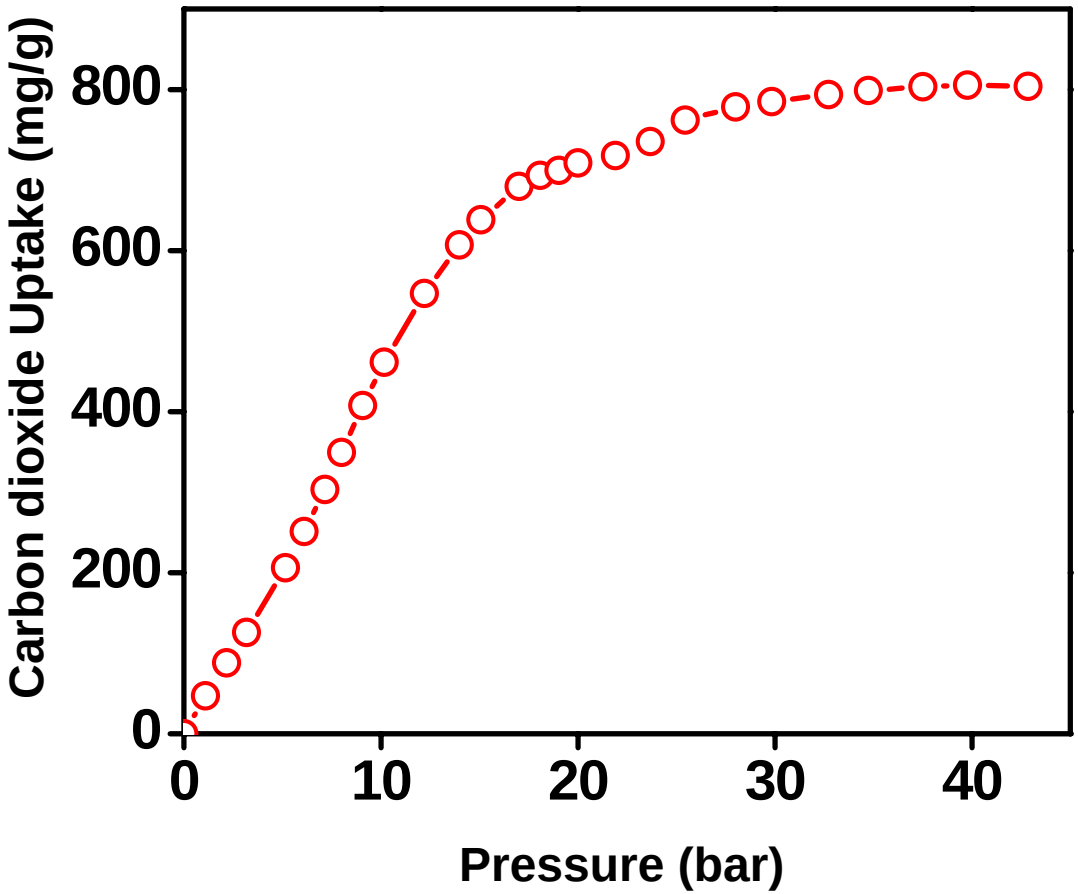
	Power 25%
Langmuir Area (m^2/g)	3200–4000
Micropore Area (m^2/g)	2400–3000
Pore volume (cc/g)	1.20–1.60
Micropore Volume (cc/g)	1.13–1.45



	Power 75%
Langmuir Area (m^2/g)	2700–3000
Micropore Area (m^2/g)	2000–2200
Pore volume (cc/g)	1.00–1.12
Micropore Volume (cc/g)	0.95–1.07

RESULTS & DISCUSSION

- CO_2 adsorption capacity of microwave synthesized MOF-5



Conclusions

- MOF-5 was successfully synthesized by microwave heating with ca. 3000-4000 m^2/g surface area.
- Synthesis period of MOF-5 was reduced from 2 days to 5-25 min.
- CO_2 adsorption capacity of MOF-5 synthesized by microwave was 805 mg/g at 40 bar.