

# Adsorption of Carbon Dioxide on Mesoporous Alumina



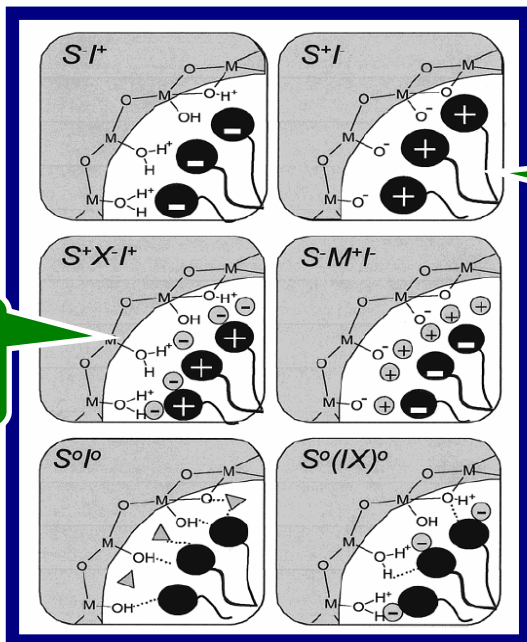
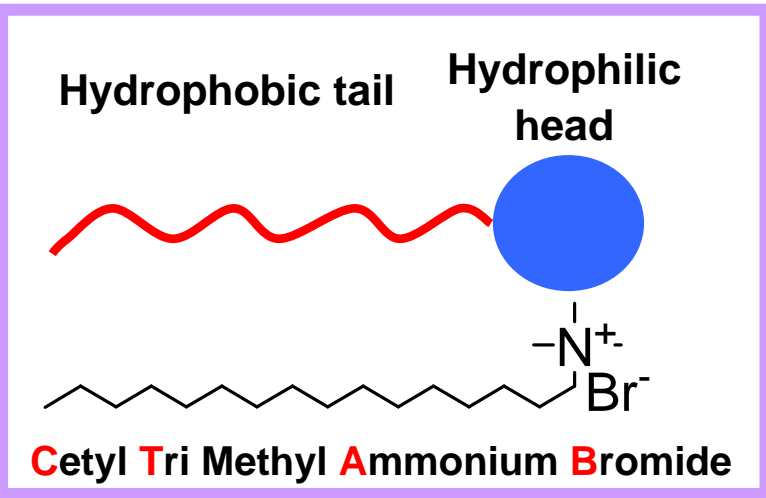
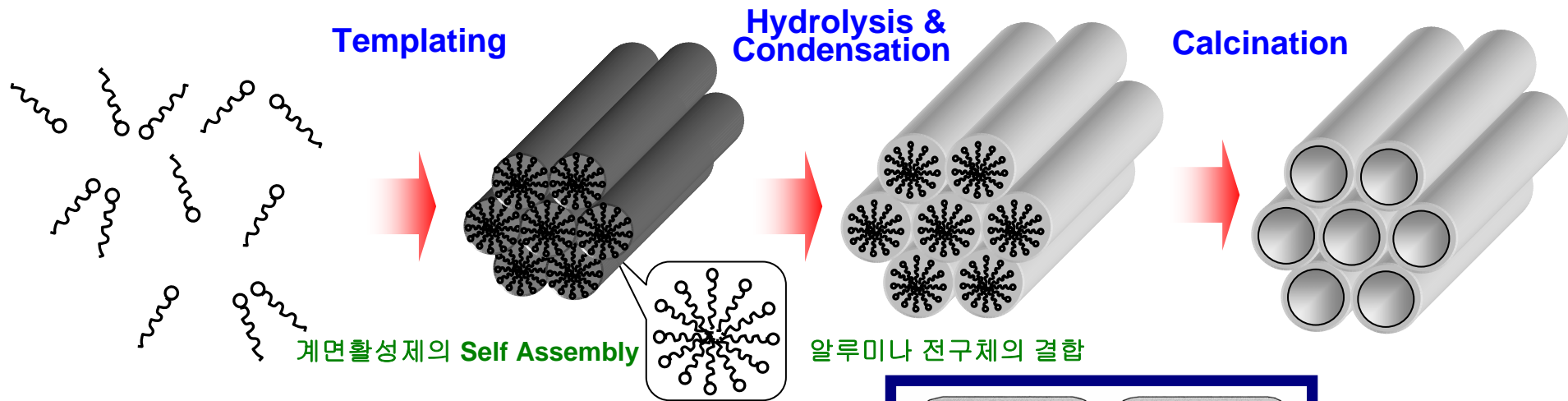
*Department of Chemical Engineering, Inha University*

**Xiong Li, Wha-Seung Ahn\***

# Introduction

The regenerable solid adsorbents with a high surface area and high adsorption capacities is a potential alternative for carbon dioxide adsorbent because such materials are more environmentally benign and easier to handle compare to liquid phase adsorbents. In this work, we have successfully synthesized mesoporous alumina in the presence of a cationic surfactant under hydrothermal condition. The prepared carbon dioxide adsorbent contains a wormhole-like mesopore structure and exhibits high surface area of ca. 480 m<sup>2</sup>/g and pore volume of 0.82 cm<sup>3</sup>/g. The adsorption capacity of mesoporous alumina on carbon dioxide was measured by using thermal gravimetric analysis (TGA).

# Synthesis mechanism of mesoporous alumina



알루미나 전구체

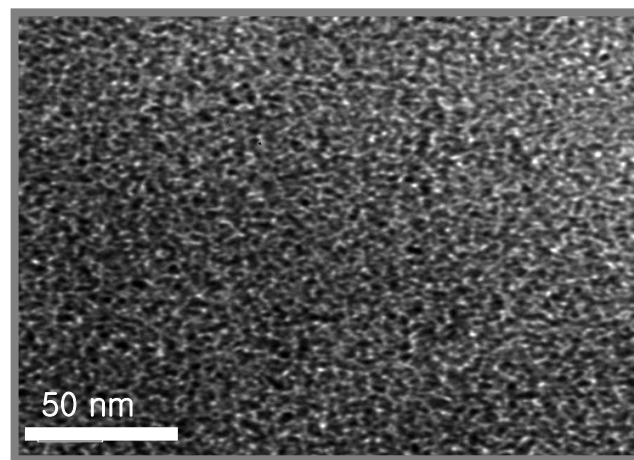
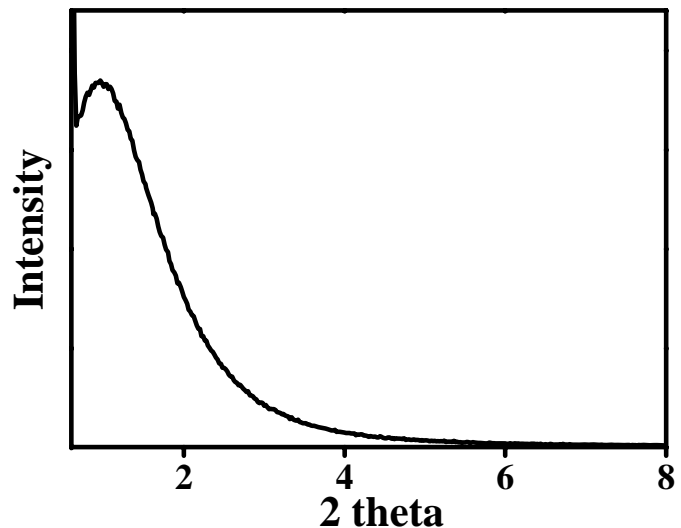
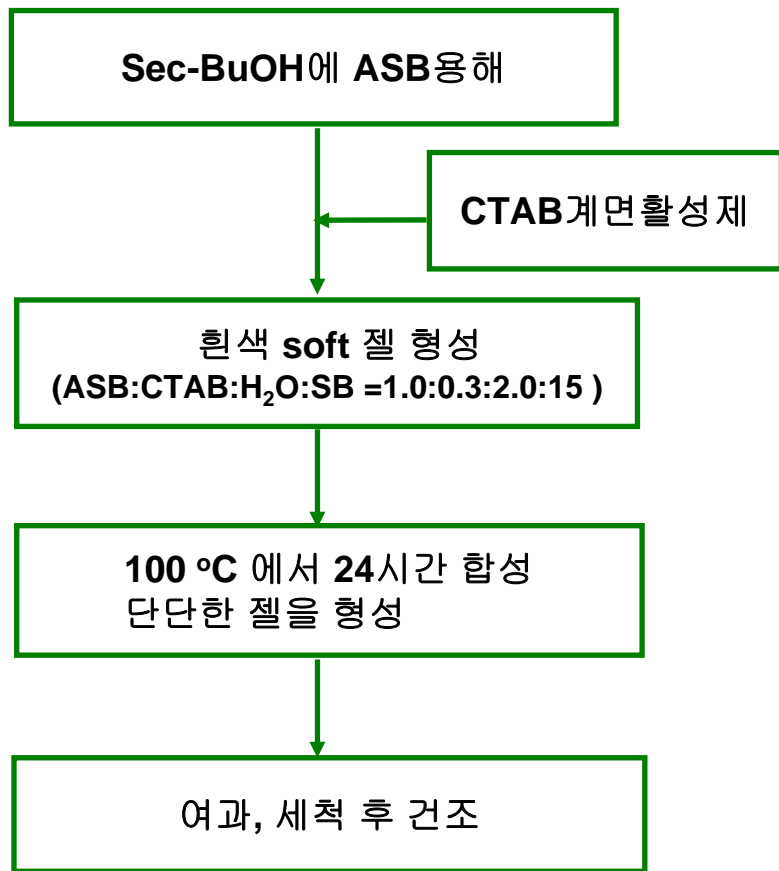
계면활성제

# Synthesis method of mesoporous alumina

-양이온성 계면활성제를 이용한 메조세공 알루미나 합성-

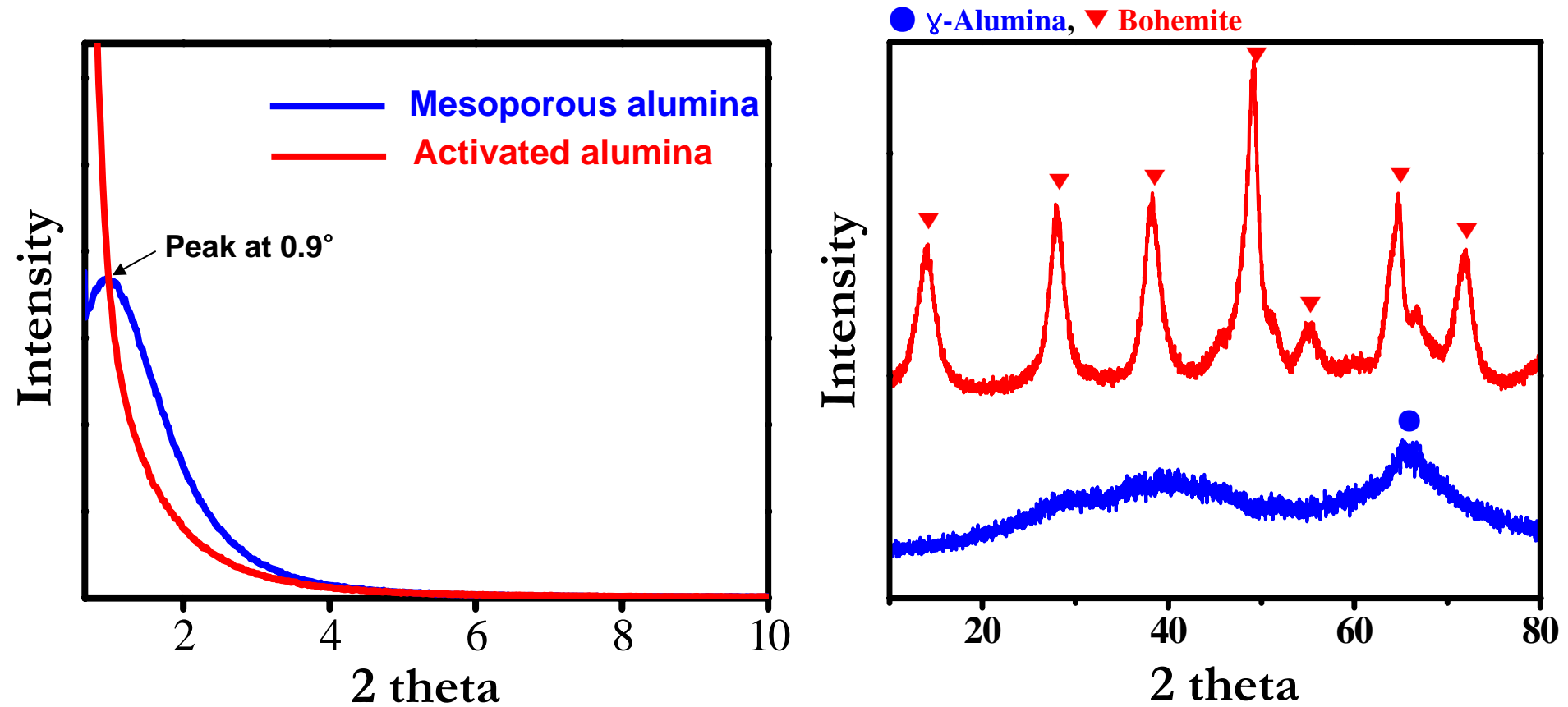
CTAB : Cetyltrimethylammonium bromide,

ASB :  $\text{Al}(\text{O}-s\text{-Bu})_3$ , SB : sec-butanol



# Results & Discussion

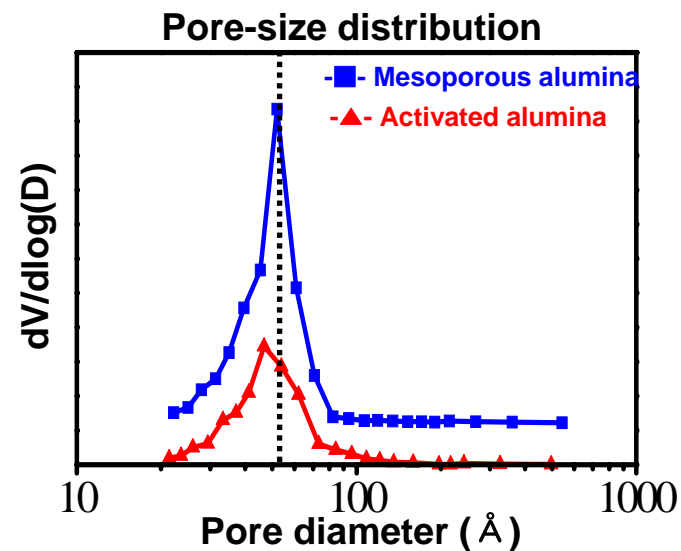
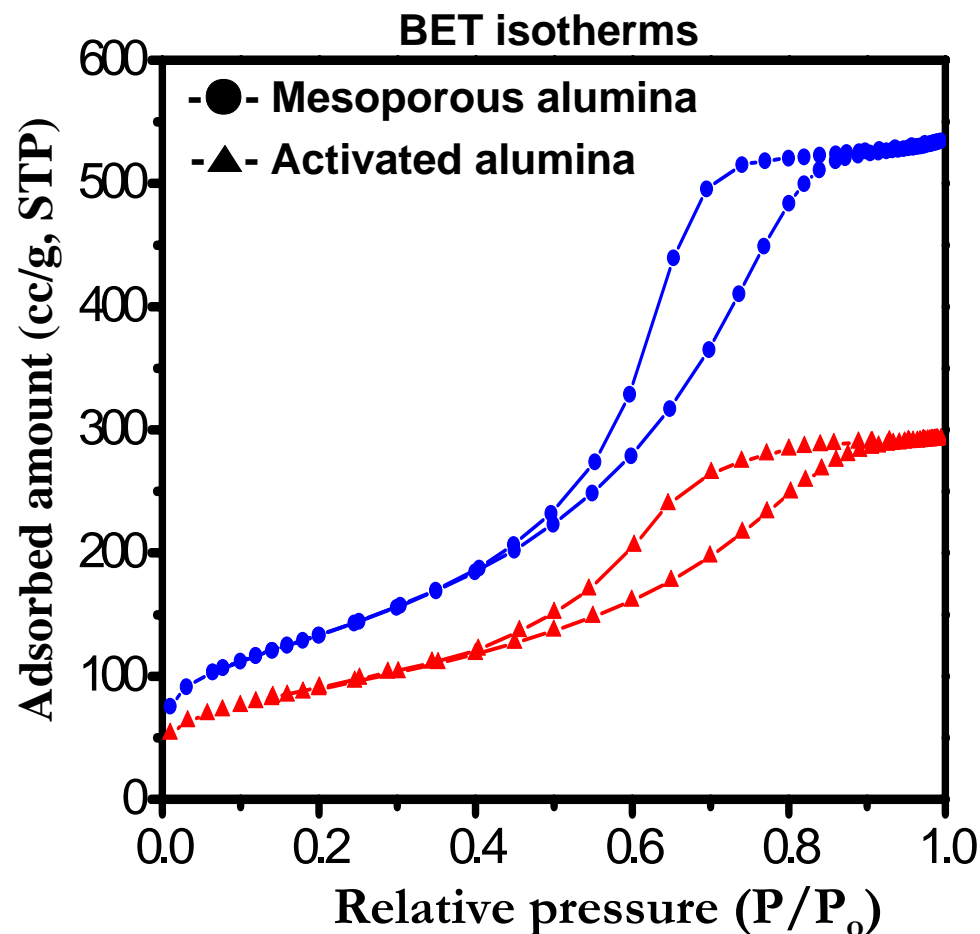
## - X-ray diffraction patterns -



**\*\* Before the XRD measurement each sample was pretreated at  $200^\circ\text{C}$  for several hours.**

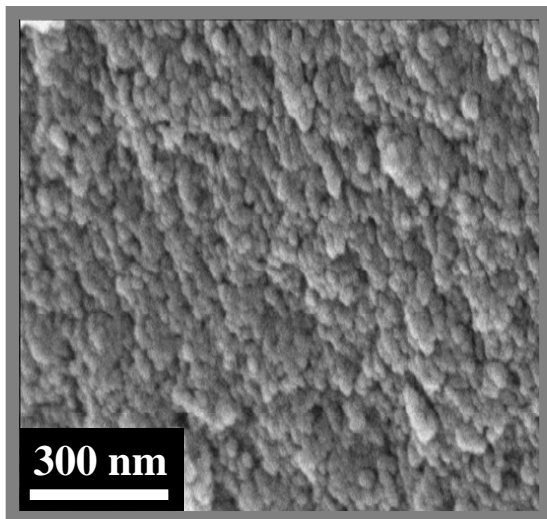
# Results & Discussion

## - Nitrogen adsorption-desorption analysis -

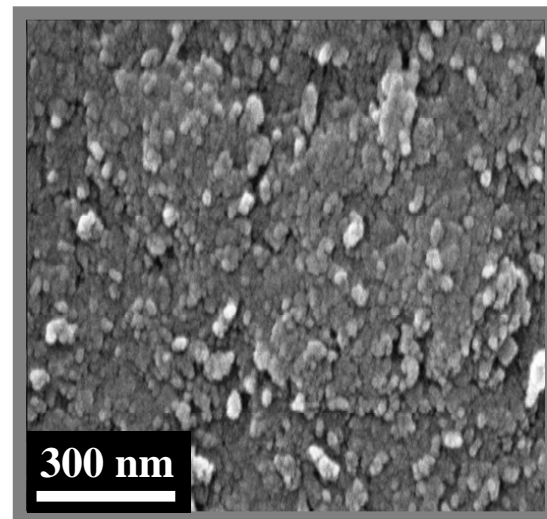


	Surface area $\text{m}^2/\text{g}$	Pore vol. $\text{cm}^3/\text{g}$	Pore dia. $\text{\AA}$
activated alumina	320	0.45	56
Mesoporous alumina	480	0.82	68

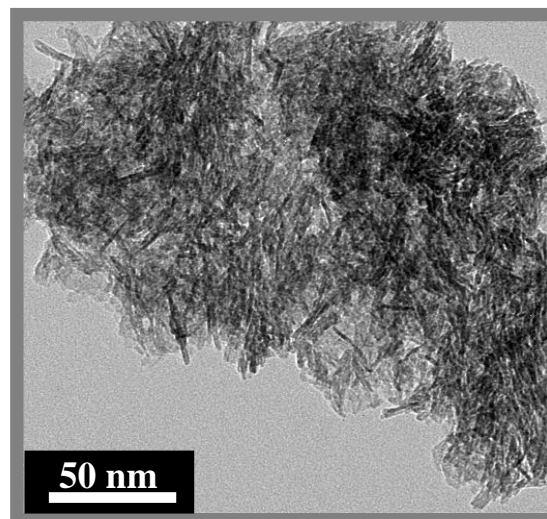
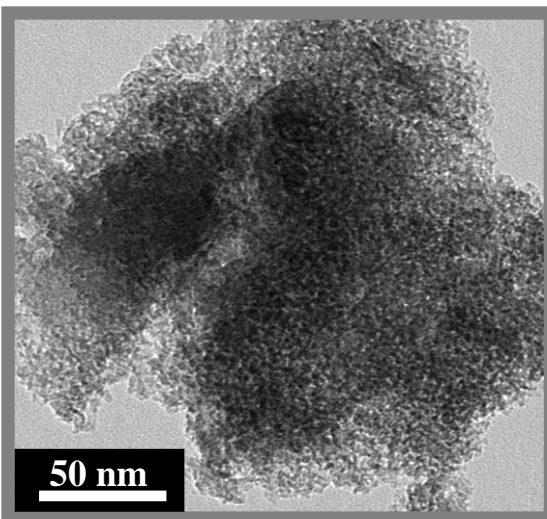
메조 알루미나



activated 알루미나



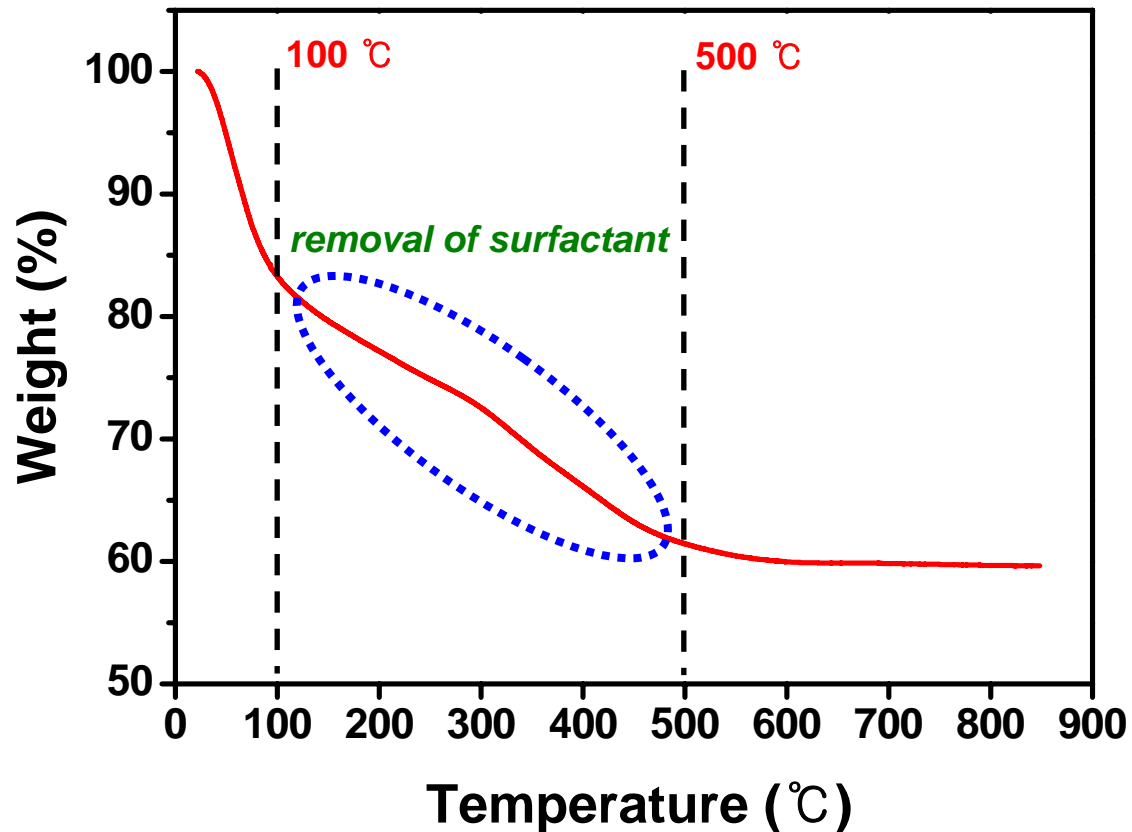
SEM



TEM

# Results & Discussion

TGA thermogram of the as-synthesized mesoporous alumina

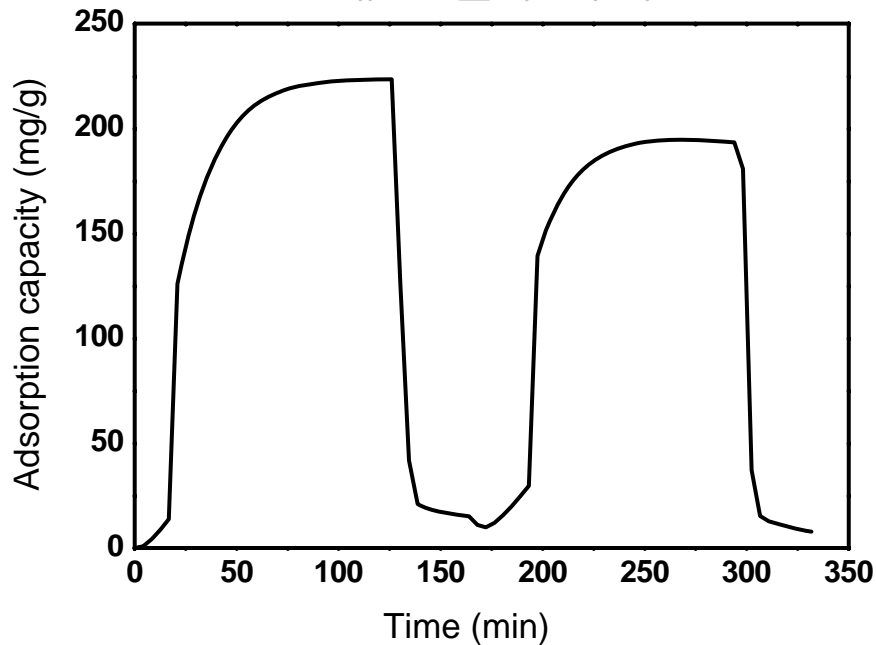




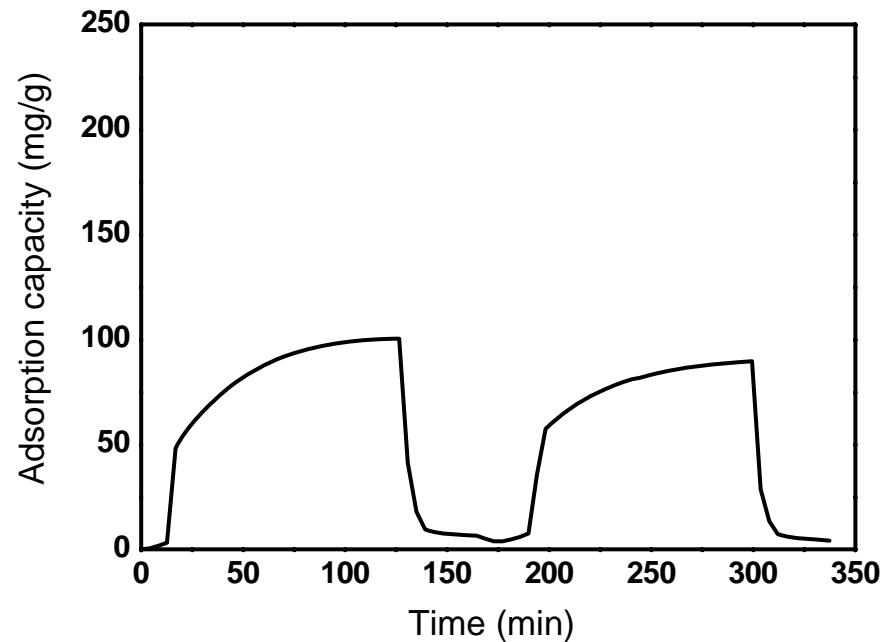
# Results & Discussion

## - CO<sub>2</sub> adsorption-desorption cycle -

메조 알루미나



activated 알루미나

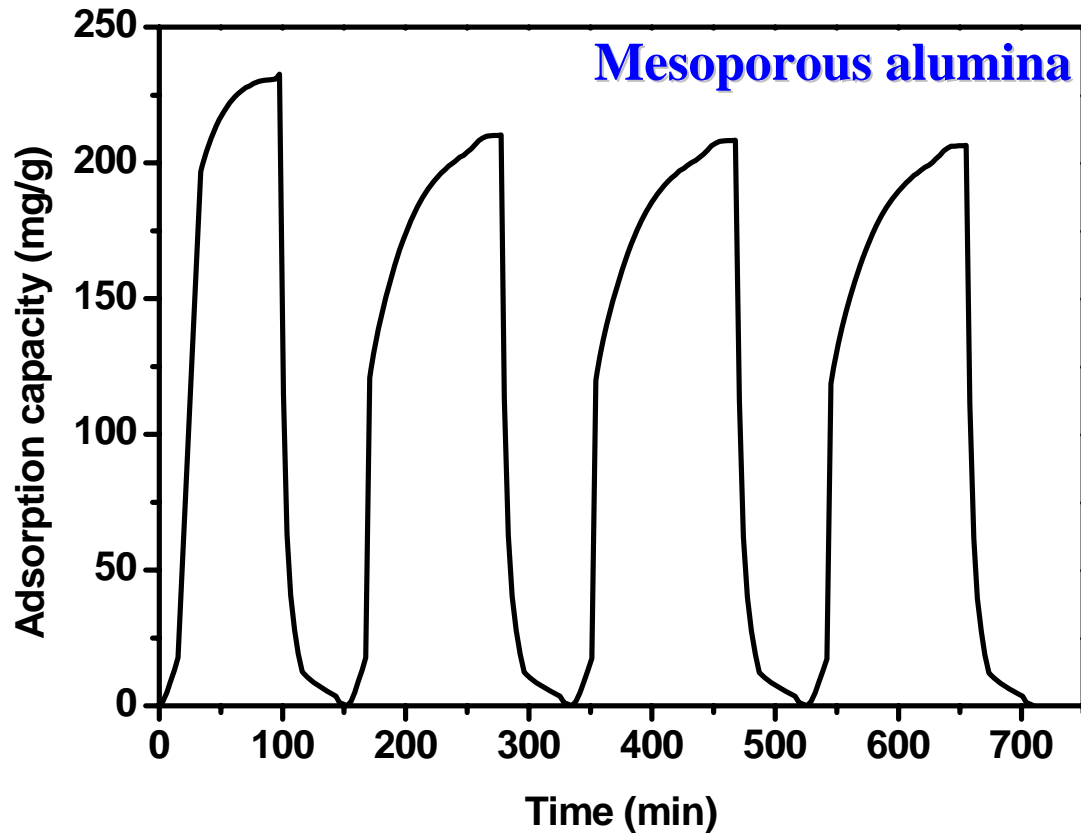


adsorption gas : 5% CO<sub>2</sub>/He ; pretreatment : 350 °C, 30 min

adsorption step : 25 °C, 120 min ; desorption step : 250 °C, 30 min

# Results & Discussion

- CO<sub>2</sub> adsorption-desorption cycles -

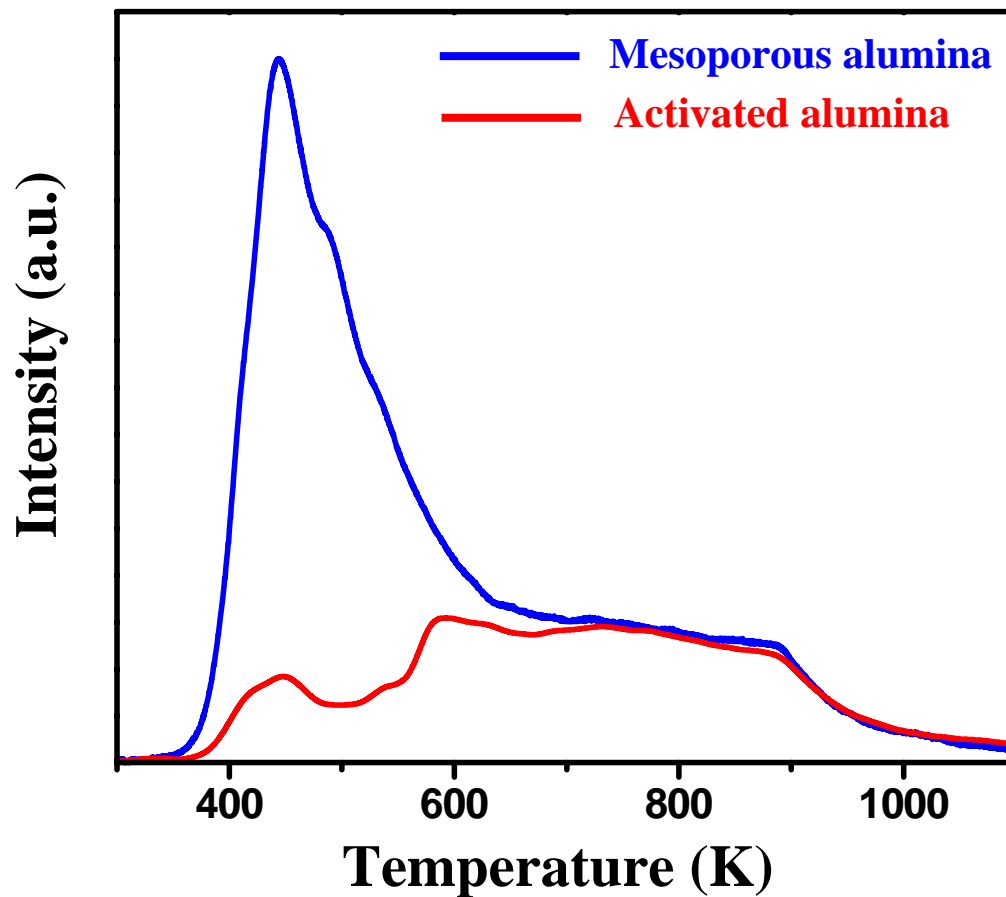


adsorption gas : 5% CO<sub>2</sub>/He ; pretreatment : 350 °C, 30 min

adsorption step : 25 °C, 120 min ; desorption step : 350 °C, 30 min

# Results & Discussion

- CO<sub>2</sub> TPD analysis -



# Conclusions

**Mesoporous alumina adsorbent showed substantially improved carbon dioxide adsorption capacity (220 mg/g sorbent) compare to the commercial activated alumina (100 mg/g sorbent). More importantly, the 91% of carbon dioxide adsorption performance on mesoporous alumina was maintained after one adsorption-desorption cycle.**

**This result indicate that on the mesoporous alumina the adsorption-desorption process of carbon dioxide is thermally reversible and the 9% of adsorption capacity decrease is believed to be a consequence of strong chemical interaction between carbon dioxide and the strongly basic active sites within the mesoporous alumina framework.**