초고압 균질기를 이용한 Cu-MnO_2 나노 촉매입자 제조 및 물성 분석

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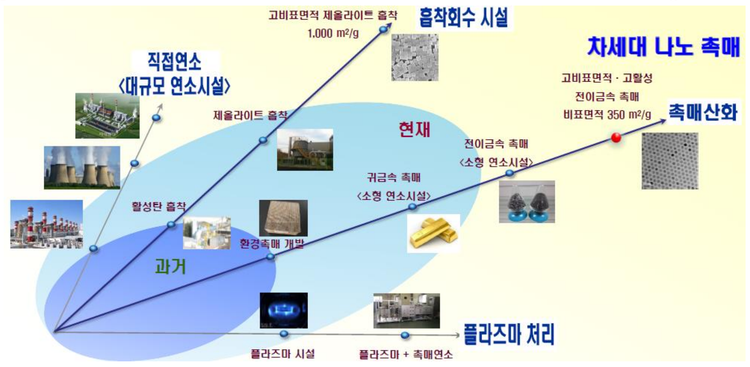
1. Introduction

➢ Applications of Metallic oxide Nano-catalysts

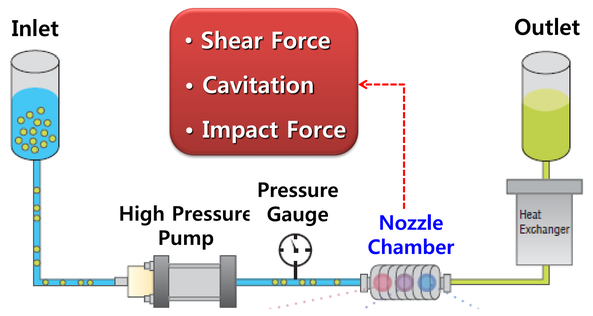


- Metallic oxide nano-catalyst have received intensive interest in recent years due to their potential applications in various fields, such as in petro-chemistry, motor industry, boiler, air pollution, environmental field

➢ Objectives of This Study

- Synthesis of uniform a metallic oxide catalyst nanoparticles using a high pressure homogenizer without any dispersing agent.
- Control of the size of the metallic oxide nanoparticles.
- Analysis of property a metallic oxide catalyst nanoparticles

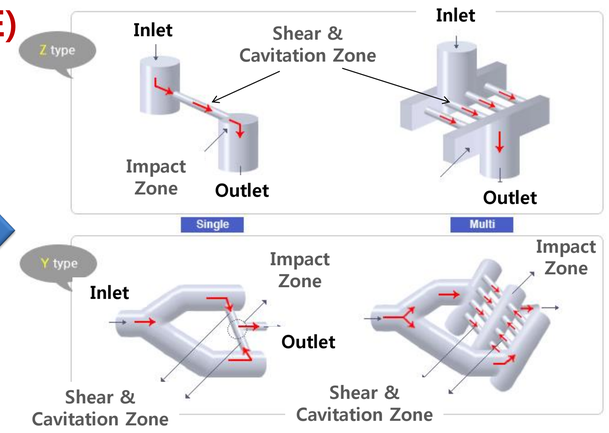
➢ High Pressure Homogenizer (HPH, Nano Disperser, ILSHIN AUTOCLAVE)



➢ Fluid Velocity (Sound Speed: 340 m/s)

Pressure (bar)	500	1000	1500	2000	2500
Fluid velocity (m/sec)	313	442	542	626	700

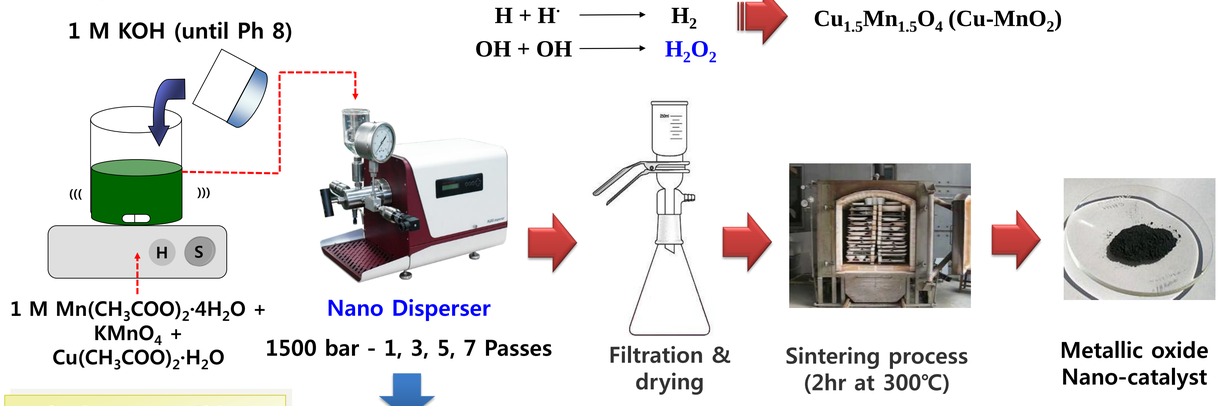
➢ Nozzle Chamber



- Cavitation
  - the formation, growth, and implosive collapse of bubbles in a fluid
- Cavitational Collapse
  - intense local heating(~5000 K)
  - high pressures(~1000 atm)
  - enormous heating and cooling rates(10^{-9} K/sec)
- Advantages
  - Highly dispersion by high energy, Short process time

2. Experimental & Results

➢ Experimental



$H_2O \xrightarrow{\text{Nano Disperser}} H + OH$

$H + H \rightarrow H_2$

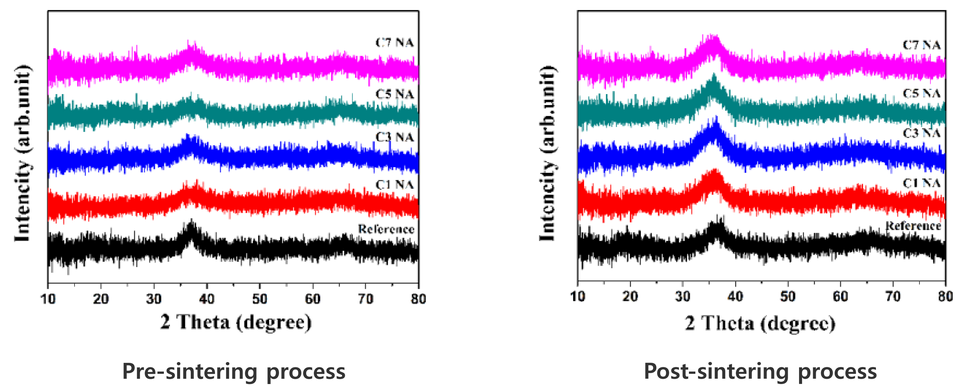
$OH + OH \rightarrow H_2O_2$

$\Rightarrow Cu_{1.5}Mn_{1.5}O_4$ (Cu-MnO_2)

∗ Optimum conditions:
- Reaction Temp.: R.T
- Stirring Time: 5 min

- High pressure homogenization in a solution during the chemical reaction may accelerate the rate of the reaction and the crystallization may be possible at low temperature.

➢ XRD Patterns

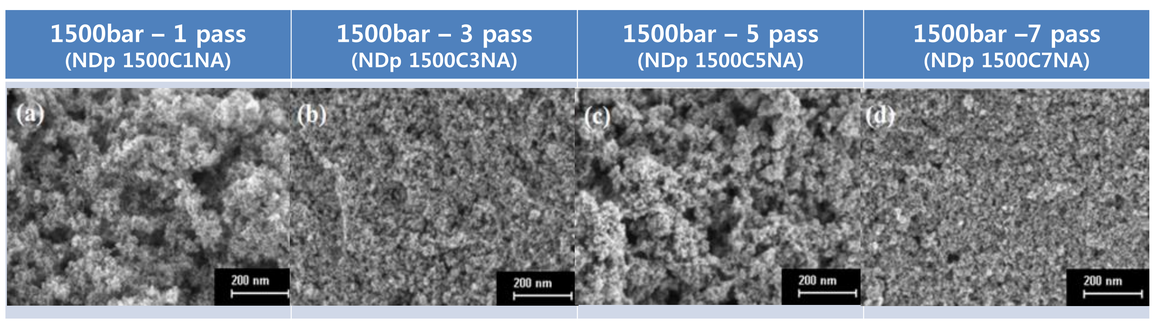


- The XRD pattern of before and after sintering sample showed diffraction peaks from the $Cu_{1.5}Mn_{1.5}O_4$.
- All samples synthesized uniform powders showed the same peak of X-ray diffraction pattern.

3. Results & Discussion

➢ SEM Images

1500bar – 1 pass (NDp 1500C1NA)	1500bar – 3 pass (NDp 1500C3NA)	1500bar – 5 pass (NDp 1500C5NA)	1500bar –7 pass (NDp 1500C7NA)

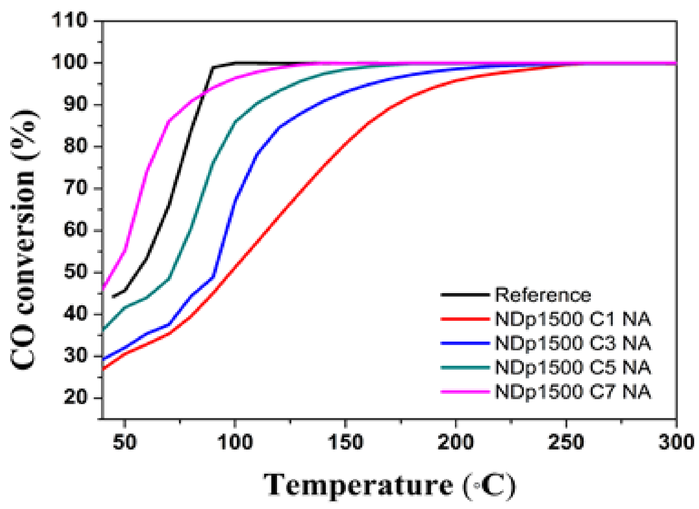


➢ Property of nano-catalyst particle

	Average Particle Size (nm)	Specific surface area (m^2/g)	phase	Catalystic activity (CO oxidation)	
				$T_{50\%}$	$T_{85\%}$
0 Pass	7.7	204.0	-	55.5	80.8
1 Pass	9.8	185.7	spherical	98.0	158.7
3 Passes	9.2	190.8	spherical	91.6	120.5
5 Passes	8.5	210.2	spherical	72.7	98.1
7 Passes	8.0	222.1	spherical	45.1	68.2

- As the number of nozzle passes increases through 1 to 7 passes at 1500bar sample, the specific surface area increases.
- Spherical catalyst nanoparticles were obtained for 1 to 7 passes at 1500 bar.

➢ Catalystic activity



4. Conclusion

➢ We have synthesized uniform metallic oxide nano-catalyst using the high pressure homogenizer without dispersing agent and oxidant.

➢ The X-ray diffraction patterns showed that all the samples had $Cu_{1.5}Mn_{1.5}O_4$ x-ray peaks.

➢ The average particle size decreased with increasing number of nozzle passes, and was the smallest at 8nm when passed through 7 passes.

➢ CO oxidation measurements revealed low temperature catalytic activity of the Cu-MnO_2 particles for 1 and 7 passes at 1500 bar.

➢The uniform size, narrow distributions and metallic oxide particles of these catalyst nanoparticles demonstrated their suitability for use as petro-chemistry, motor, boiler, breathing mask, etc.

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