# SIIC118

## THE OVERVIEW OF AN OVERVIEW OF NiCo/$SiO_2$ FOR $CO_2$ METHANATION: EFFECT OF CALCINATION TEMPERATURE

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***Abstract:***
The studies is made to review and identify the previous researches on NiCo/$SiO_2$ catalyst for $CO_2$ methanation with the effect of calcination temperature. $CO_2$ methanation is the process to reduce the emission of anthropogenic gas which is carbon dioxide by the combination with hydrogen to produce methane gas. The review had been made based on the previous research on nickel-based catalyst, nickel-cobalt catalyst and the effect of calcination temperature on the catalyst. Most of the research stated that the catalyst was prepared by impregnation. After the preparation of catalyst, some of researches tested the catalyst first. The characterization of the catalyst had been made $N_2$ adsorption – desorption isotherms using BET, X-ray powder diffraction (XRD), temperature programmed reduction (TPR), temperature programmed desorption of $H_2$ ($H_2$-TPD), and $CO_2$ ($CO_2$-TPD). For nickel-based catalyst, the result obtained from the researches involve the nickel content in the catalyst. The amount of nickel content can affect the specific surface area, crystalline size, pore size distributions and $CH_4$ selectivity. The performance of the particle also increased. The better selection of the catalyst is the catalyst must have a good reducibility of catalyst, large specific surface area and high $CO_2$ conversion and $CH_4$ selectivity. The bigger pores can allow the easier diffusion of water and air molecules. The research will undergo the process at the different reaction temperature in order to study the effect of calcination temperature. The most common calcination temperature that used in the research is between 250℃ to 900℃. The catalyst at different calcination temperature resulting in different characteristics and performance of the catalyst. The different calcination temperature used gave the different characteristics of the catalyst. Some researchers found that the optimum calcination temperature is above 500 ℃. The optimum calcination temperature will give the better catalytic performance of the catalyst. Nickel based catalyst is the commonly used catalyst due to its performance and low cost. The metal loading in catalyst can affect the catalytic performance. The catalyst activity and characteristics also can be affected by reaction temperature and composition. The propose to increase the stability of the catalyst is by adding some catalyst addictive. The catalyst addictive also can be added to increase the stability of the catalyst. From the review, the conclusion can be made by observing the result obtained from the characterization. The proper selection of support catalyst also can affect the characterization of the catalyst.

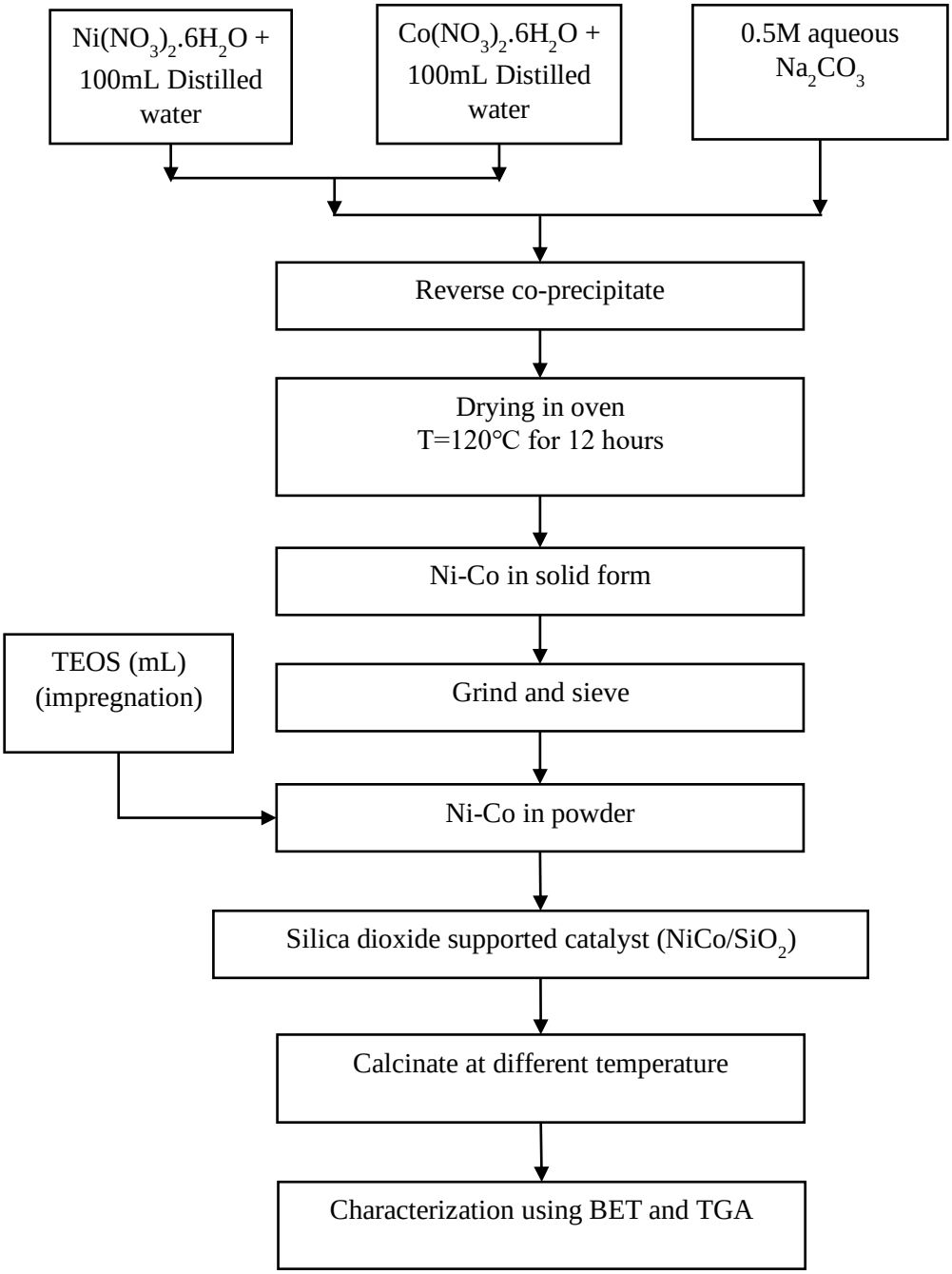
***Keywords*:**

Carbon dioxide, $CO_2$ methanation, nickel-based catalyst, calcination temperature.

***Objectives:***

- To review about the $NiCo/SiO_2$ catalyst use for $CO_2$ methanation.
- To review the effect of calcination temperature of $CO_2$ methanation.
- To study the better parameter for better catalyst performance and activity of the structure.
- To determine the best combination of metal catalyst for $CO_2$ methanation.

***Methodology:***



***Results:***

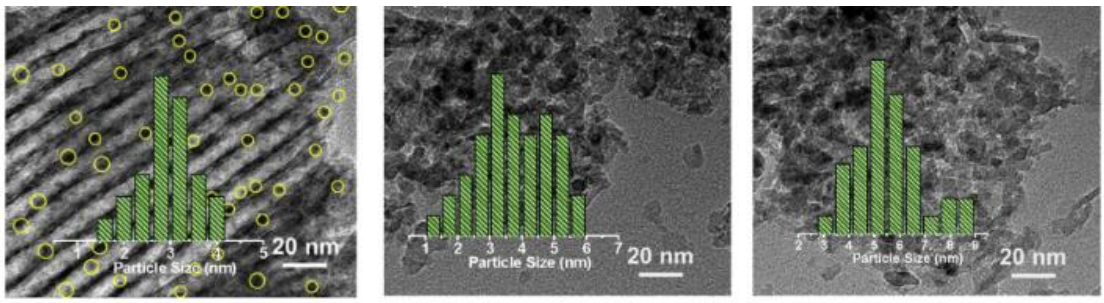



Figure 1: TEM image for 10N3COMA, 10N3CA and 10NA. [79]

| Sample | $S_{BET}$ ($m^2\ g^{-1}$) | $V_p$ ($cm^3\ g^{-1}$) | Crystallite size (nm)[a] | $H_2$ uptake ($\mu mol\ g^{-1}$) |
|---|---|---|---|---|
| 10N3COMA | 160.1 | 0.45 | <5.0 (3.0) | 51.9 |
| 10N3CA | 142.4 | 0.43 | <5.0 (4.1) | 48.6 |
| 10NA | 146.9 | 0.42 | 5.2 | 47.6 |

[a] Considering the limitation of the Debye-Scherrer equation, the crystallite size was denoted as '<5.0' when the calculated value was smaller than 5.0 nm. Also, the calculated values were described in the brackets.

Figure 2: The characterization of catalysts

***Conclusion:***

Nickel based catalyst is one of the commonly used catalyst due to its high catalytic performance and low cost. Nickel based catalyst is easy and economical to achieve. Carbon dioxide known as the anthropogenic gas which can come so many harmful effects to the environment. $CO_2$ methanation is one of the process that can reduce the emission of $CO_2$. The better catalyst needs to be selected to ensure the process can achieve the optimum performance. The function of catalyst is to increase the efficiency and rate of reaction for the $CO_2$ methanation process. Metal loading in catalyst can affect the catalytic performance. The catalyst activity and characteristics also can be affected by other effect such as temperature and composition. The support of the catalyst is needed to enhance the stability of the catalyst. The support also acts as the medium to absorb the carbon dioxide ($CO_2$) and hydrogen ($H_2$). Based on the overview of previous researches, the composition of the nickel can affect the characterisation of the catalyst. The specific surface area, pore size distribution and pore volume are observed to be decrease when the nickel loading in the catalyst increase. The crystalline size is observed to be increase with the increasing of the nickel content. The decrease of specific surface area lead to decrease of pore volume because the pores will be partially blockage by nickel oxide cluster. The good catalyst has the good reducibility of catalyst and have a high $CO_2$ conversion and $CH_4$ selectivity. The bigger pores are better to allow the diffusion and release of air and water molecules. It also can increase transportation of the molecules. The nickel - based catalyst combined with other metal such as cobalt. The increase of cobalt contents in the Ni - Co catalyst can increase the methanation activity. It can give the high stability and high catalytic activity.