**Nano structured Nickel promoted CeO2-based catalyst for Methanation of CO2 to produce synthetic natural gas**

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Carbon dioxide (CO2), which is considered to be one of the most prominent greenhouse gases, has had a long-term impact that is significant on the shift in the global climate. Consequently, CO2 emissions have garnered a lot of attention around the world. Recently, CO2 is the most promising and cost-effective C1 carbon source due to the fact that it can be hydrogenated into valuable products, such as ethanol, methane, methanol, formic acid, and others, by varying the degree of CO2 reduction. For this purpose, CO2 methanation is very adaptable and promising technology that supports both the development of sustainable energy systems and initiatives to reduce greenhouse gases. In order to decrease the kinetic energy barrier and increase the CO2 methanation reaction efficiency, this reaction is often carried out in the presence of a metal catalyst. Due to a number of advantages, including their low cost and high activity, Ni-based catalysts have gained popularity. The amount of accessible Ni active sites and the size of the Ni nanoparticles not only have a significant impact on the activity of Fe-based catalysts, but also play a significant role in a wide range of physiochemical properties of the supports, including oxygen vacancy sites, basicity, metal-support interaction, reducibility, etc. Therefore, the use of nano-CeO2 as a support has been gaining is gaining attention of the researchers. It is well established that the surface oxygen vacancies in the nano-CeO2 support play a key role in controlling oxygen storage and release as well as the development of moderately basic sites for CO2 chemisorption. In this study we have successfully synthesized nano structured Ni promoted CeO2-based catalyst using wet impregnation method. SEM, TEM, XRD, and FTIR analyses, together with N2-adsorption-desoption testing, were used to determine the properties of the produced catalysts. The synthesized nano structured Ni promoted CeO2-based catalyst exhibited excellent with high selectivity 86% and CO2 conversion of 92%. Based on the findings, it is possible to conclude that nanostructured Ni promoted CeO2-based catalysts have a high potential for industrial application.