CO_2 methanation: catalysts for CCU technologies

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Carbon dioxide capture, conversion, and storage (CCCS) technologies are emerging as pivotal solutions for utilizing carbon dioxide as a C1 building block[1]. An intriguing solution lies in CO_2 methanation, leveraging existing methane grids globally and a clear regulatory framework. In our study, carbon dioxide methanation experiments were performed with two different setups, respectively operated at atmospheric and high-pressure. The former was used to conduct the catalyst screening while the latter was used to perform high-pressure tests and GHSV studies in a SS-316 tubular reactor. He was used as a diluent gas and N_2 was used as GC internal standard. The influence of Ni-loading, supporting materials and catalyst synthesis technique on the catalytic activity were investigated. Several oxides, such as ZrO_2, TiO_2, MgO, Al_2O_3, ZSM-5, SiO_2 and CeO_2, were tested as supports. CeO_2 showed extremely interesting performances, achieving high CO_2 conversion rates at high GHSV, as shown in Figure 1. Different preparation methods, such as sol-gel, co-precipitation and wet impregnation were investigated for the preparation of the Ni/CeO_2 catalyst. Several catalysts exhibited promising performance and despite the relatively high loadings, Ni catalysts emerged as viable alternatives to noble metal-based catalysts.

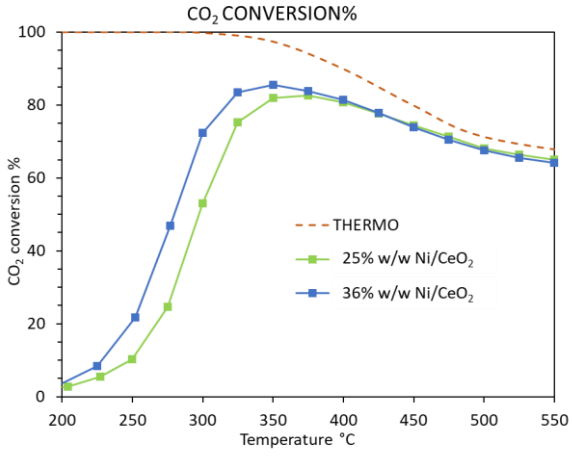

Figure 1. CO_2 conversion as function of the temperature for Ni/CeO_2 catalysts

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[1] S.A. Theofanidis, A.N. Antzaras, A.A. Lemonidou, *Curr. Opin. Chem. Eng.* **2023**, *39*, 100902.