Recyclable Ni@Al_2O_3 catalyst for Dry Reforming of Methane

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Significance and Relevance

A Ni@Al_2O_3 catalyst with a core-shell like structure was tested for Methane Dry Reforming (DRM). Studies suggest that protecting the metal's active site can prevent deactivation caused by sintering and coke deposition. In this study stability tests and several regeneration cycles were performed, demonstrating that the different catalytic structure obtained is suitable for DRM purposes.

Preferred and 2nd choice for the topic: H_2 storage and transportation, green H_2 production, hydrogen vectors, CO_2 utilization and recycling

Preferred presentation: Poster

Introduction and Motivations

Dry reforming of Methane is a catalytic reaction that converts two of the most impactful greenhouse gases - CH_4 and CO_2 - into syngas[1]. The reaction has not been applied yet at industrial level due to two major deactivation challenges: sintering of the metal active phase and coke deposition. The first one is related to the high temperature required by the reaction's endothermic nature. The second one is related to secondary side reactions[2]. To address the deactivation problems, the metal active site (Ni) can be surrounded by a metal oxide shell (Al_2O_3), which protects the Ni and provides a confinement effect.

Materials and Methods

The obtained catalyst was tested for the DRM reaction at 650 °C in a fixed bed reactor with a GHSV of 12000 h^{-1}, using a CH_4:CO_2:He ratio of 1:1:18, under a total flow of 200 mL/min. Additionally, recycling tests were conducted.

The fresh and spent samples were characterized using various techniques such as XRD, SEM, TEM, TPR, TPO, and N_2 physisorption.

Results and Discussion

The activity test demonstrated that the catalyst has an active and stable catalytic behaviour achieving a good H_2/CO ratio. In addition, the recycling test showed that the catalyst effectively converts the reactant gases into syngas, being stable for up to five redox cycles.

References

1. M. Pizzolato, G. Da Pian, E. Ghedini, A. Di Michele, F. Menegazzo, G. Cruciani, and M. Signoretto, *Reactions*, **2022**, *3*, 634 – 647.

2. M. Pizzolato, G. Da Pian, E. Ghedini, A. Di Michele, F. Menegazzo, G. Cruciani, and M. Signoretto, *Catalisys Today*, **2023**, *418*, 114041.