

# Catalytic conversion of methane and CO<sub>2</sub> to synthesis gas over NiAl-LDH hydrotalcite-derived catalysts synthesised by microwave

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**1. Introduction** – CO<sub>2</sub> reforming of methane, also named dry reforming of methane, is a method of producing hydrogen from the reaction of carbon dioxide with methane (DRM, CH<sub>4</sub> + CO<sub>2</sub> ⇌ 2H<sub>2</sub> + 2CO). The major problem associated with this reaction is the sintering of the active phase and carbon formation [1]. The carbon generated during this reaction can be the result of direct decomposition of methane (CH<sub>4</sub> → C + 2H<sub>2</sub>) or the Boudouard reaction (2CO ⇌ CO<sub>2</sub> + C) [1,2]. Many ideas were put forward by scientists to develop catalysts bearing both high activity and high resistance to coke. The activity of a catalyst is related to the metal surface area, i.e., the number of active sites [2]. This implies that the catalytic activity is proportional with the high dispersion of metal particles. The aim of the present work is to investigate the utilization of NiAl-CO<sub>3</sub> hydrotalcite-like (Image 1) compounds, prepared by microwave-assisted hydrothermal treatment, over different reaction of times (t=0,10, 30, 60 and 120min). This is performed in the hope of obtaining a smaller active phase and a good dispersion.

**2. Experimental** – The products obtained, after heat treatment under air at 800 °C, were characterized by XRD, AAS, TPR, BET, SEM and TEM. For reaction tests, usually 0.1 g of catalyst was pretreated under H<sub>2</sub> at 750°C for 1h. After calcination and reduction, the solids named: NiAl<sub>0min-cal</sub>-R, NiAl<sub>10min-cal</sub>-R, NiAl<sub>30min-cal</sub>-R, NiAl<sub>60min-cal</sub>-R and NiAl<sub>120min-cal</sub>-R. A reaction mixture CH<sub>4</sub>:CO<sub>2</sub>:Ar with feed ratio 20:20:60 at a flow rate of 20 ml/min was used for all reaction tests.

**3. Results and Discussion** – The results of the elemental analysis by AAS show that the molar ratios Ni<sup>2+</sup>/Al<sup>3+</sup> = 2. The decomposition of the precursor at 800°C for 15 h led to the formation of the oxide powder as confirmed by XRD. NiAl<sub>30min-cal</sub>-R exhibited high catalytic activity and stability during the reaction. This catalyst also possessed essential advantages like resistance to metal sintering and carbon deposition.

**4. Conclusions** - The NiAl<sub>30min-cal</sub>-R catalyst, exhibited rather high catalytic activity and stability during the reaction of DRM, compared to the other solid catalysts. This catalyst also possesses essential advantages like resistance to metal sintering and carbon deposition. The CH<sub>4</sub> conversion during steady state was found to decrease in the following order: NiAl<sub>30min-cal</sub>-R > NiAl<sub>120min-cal</sub>-R ≈ NiAl<sub>60min-cal</sub>-R > NiAl<sub>10min-cal</sub>-R > NiAl<sub>0min-cal</sub>-R. The high performance of the catalytic process can be explained by: i) a very high specific surface area and ii) lower size of nickel.

**Key words:** hydrotalcite, microwave, Ni, methane dry reforming.

## 4. References

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