Nickel based hexaluminates: a new type of OCM catalysts

Juan P. Holgado*[1], Nora Touahri[2], Ammel Bennada[2], Alfonso Caballero[1]

[1] Instituto de Ciencia de Materiales de Sevilla y Departamento de Química Inorgánica, Centro mixto CSIC-Universidad de Sevilla, Avda. Américo Vespucio 49, 41092 Sevilla, Spain.
[2] USTHB, Fac Chim, Lab Mat Catalyt & Catalyse Chim Organ, BP32, Bab Ezzouar 16111, Alger, Algeria

Methane is the main component of the natural gas, and its reserves are estimated to be nowadays higher than those of oil. Its conversion, mainly to higher hydrocarbons, remains one of the essential technologies for current energy and chemical applications. From the chemical point of view, two major strategies are used: indirect transformation (mainly through gas synthesis) and direct upgrade, using processes such as aromatization, or oxidative coupling of methane. Pursue of more efficient, durable and cheap catalysts are a still a challenge in many of these processes.

Hexaaluminates, a class of aluminate compounds with ideal stoichiometry $AAl_{12}O_{19}$ and a structure derived from spinel. The ideal formula is often partially substituted in the form of $AB_xAl_{12-x}O_{19}$ where A is typically a large mono-, di- or trivalent cation, and "B" represents a transition metal partially substituting Al. A set of three Barium doped hexaaluminates, $NiBaAl_{11}O_{19}$, $Ni_{0.5}Fe_{0.5}BaAl_{11}O_{19}$and $FeBaAl_{11}O_{19}$ have been prepared by the citrate method, and calcined at temperatures between 1000-1200C. These catalysts have been characterized and catalytically tested for partial oxidation of methane.

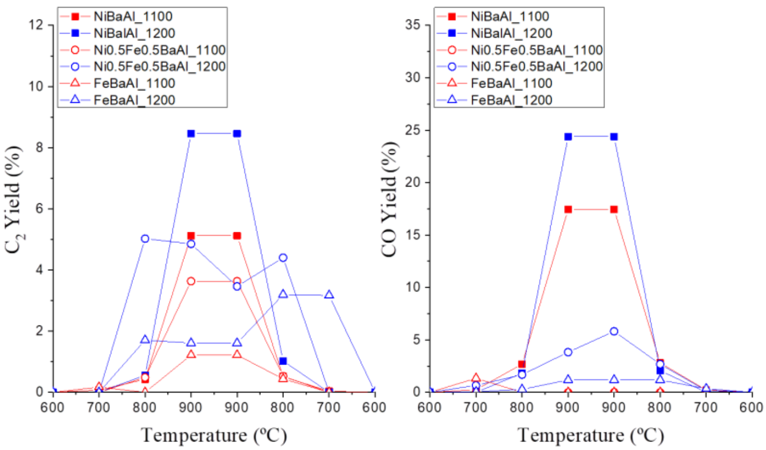

Figure 1: Catalytic performance of indicated catalysts vs temperature for partial oxidation of methane

The results indicate that samples present a well-defined hexaaluminate structure, producing a syngas ($CO+H_2$) and C_2 (ethane and ethane) mixture as products of reaction. This is a result of great interest, as nickel has been scarcely described as a possible OCM catalysts, but up to our knowledge no references in the case of hexaaluminates were found. Further improvement in the surface area of the catalysts should enhance the catalytic performance of these catalysts.