The role of the support of Mn-Na-W/Silica and Na-W/Silica

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Introduction

The reserves of natural are considered to be one of the most important future alternatives to the decreasing reserves of crude oil. Methane is the major component of natural gas [1]. For this reason, the direct methane conversion to the value-added products via the oxidative coupling of methane is of great interest for the chemical industry. However, up to date an industrial application has not been realized due to a lack of active and stable catalysts [2]. $Mn/Na_2WO_4/SiO_2$ catalyst system is known in the literature to be an active and stable catalytic system [3]. However, many facts are still unknown, for example the role of the support material SiO_2. Therefore, we studied a broad variety of support materials to elucidate its role.

Experimental

Na_2WO_4/Support and Mn/Na_2WO_4/Support catalysts were prepared, via an adapted incipient wetness impregnation method [4]. ZrO_2, TiO_2, Fe_2O_3, SiO_2, Al_2O_3, MgO, CaO, La_2O_3 and SrO were applied as the support materials, with a relatively low surface area with respect to the SiO_2 and Al_2O_3. The synthesized catalysts were characterized by BET surface area and X-ray diffraction analysis. The oxidative coupling of methane (OCM) was carried out in a packed-bed reactor, with respect to the stability of the catalyst.

Results/Discussion

Figure 1 shows the preliminary results for Na_2WO_4 and Mn/ Na_2WO_4 supported on SiO_2 and Al_2O_3. It is evident, that the activation of CH_4 takes place for both catalysts and both support materials. Moreover, Al_2O_3 as support material exhibits the highest CH_4 conversions, however, with the main drawback of rather low C_2-selectivities. The CH_4 conversions of $2\%Mn/5\%Na_2WO_4/SiO_2$ and especially of $5\%Na_2WO_4/SiO_2$, is low, which could also be a reason for their high selectivities.

The reason of the low C_2 selectivity of the Al_2O_3-supported catalysts could be their substantially higher surface areas. Besides, when the XRD patterns of the catalysts have been taken into account, it seems that the cristobalite phase of the SiO_2-supported catalysts might be needed for the good C_2 selectivity.

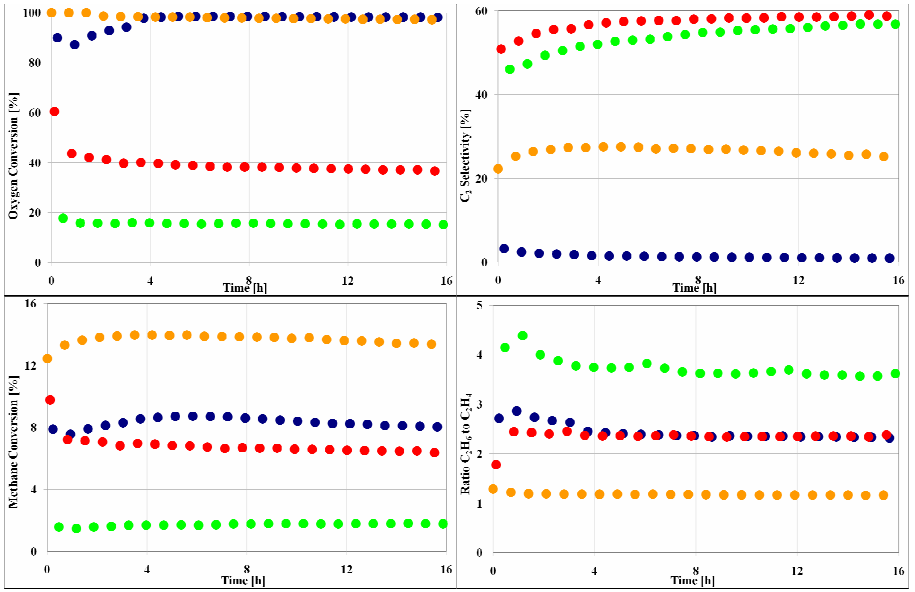

Figure 1. Catalytic activities of the Al_2O_3 and SiO_2 supported catalysts (• $5\%Na_2WO_4/Al_2O_3$, • $5\%Na_2WO_4/SiO_2$, • $2\%Mn/5\%Na_2WO_4/Al_2O_3$, • $2\%Mn/5\%Na_2WO_4/SiO_2$, T: 750°C, $CH_4:O_2:N_2$ = 4:1:4, catalyst amount: 50 mg, gas flow: 60 ml/min).

References.

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