



## 16<sup>th</sup> INTERNATIONAL CONFERENCE ON CARBON DIOXIDE UTILIZATION

### Study of new catalysts based on transition metal carbides of group 5 for the selective reduction of CO<sub>2</sub> to CO

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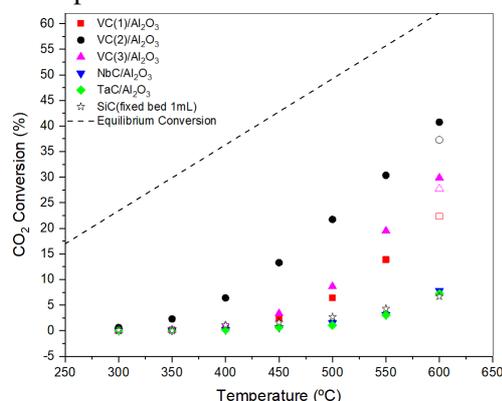
A particular approach to the use of CO<sub>2</sub> consists of its reduction to CO, by using H<sub>2</sub> as a reducing agent, through the reverse water gas shift reaction (RWGS) [1]. This reaction has been studied over metal-based (Cu, Pt) catalysts. Transition metal carbides (TMCs) have received interest because of their similar properties to noble metals in different aspects, and recently were reported to be useful for the activation of CO<sub>2</sub> [2]. The most studied TMCs as catalysts are probably those of Mo. We have recently proposed new strategies for the synthesis of Mo<sub>x</sub>C-based catalysts [3]. In this work, a new route for the synthesis of transition metal carbides such as VC, NbC and TaC is reported by using a sol-gel method; subsequently alumina-supported TMCs catalysts have been developed (Table 1). VC-based catalysts were prepared by three different methods (VC(1)/Al<sub>2</sub>O<sub>3</sub>, VC(2)/Al<sub>2</sub>O<sub>3</sub> and VC(3)/Al<sub>2</sub>O<sub>3</sub>). The catalysts were characterized in depth by different techniques before and after reaction. The catalytic behavior in the RWGS was studied at atmospheric pressure, and between 300°C and 600°C, using a reaction mixture of CO<sub>2</sub>/H<sub>2</sub>=1/3.

**Table 1.** Several characteristics of catalysts.

Catalyst	Crystallite size of MC (nm)	B.E.T. Fresh (m <sup>2</sup> .g <sup>-1</sup> )	B.E.T. Used (m <sup>2</sup> .g <sup>-1</sup> )
VC(1)/Al <sub>2</sub> O <sub>3</sub>	38	150	144
VC(2)/Al <sub>2</sub> O <sub>3</sub>	6	234	210
VC(3)/Al <sub>2</sub> O <sub>3</sub>	39	257	248
NbC/Al <sub>2</sub> O <sub>3</sub>	13	106	96
TaC/Al <sub>2</sub> O <sub>3</sub>	16	50	42

Catalysts based on NbC and TaC showed negligible activity under the experimental conditions used

(Figure 1). However, VC-based catalysts had a good performance and high CO<sub>2</sub> conversion values were achieved at 600°C. Selectivity towards CO reached values of up to 99.9% at 600°C.



**Figure 1:** CO<sub>2</sub> conversion achieved for different catalysts under the RWGS conditions used as a function of reaction temperature. Empty symbols represent conversion after 4 hours at 600°C.

Only a slight deactivation was observed after 4h at 600°C (Figure 1). The characterization of post-reaction catalysts with respect fresh catalysts did not show significant differences.

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