

## **A study of deactivation by H<sub>2</sub>S and regeneration of Ni catalyst supported on Al<sub>2</sub>O<sub>3</sub>, during methanation of CO<sub>2</sub>. Effect of the promoters Co, Cr, Fe and Mo**

**David Méndez-Mateos<sup>1</sup>, V. Laura Barrio<sup>1\*</sup>, Jesús M. Requies<sup>1</sup>, José F. Cambra<sup>1</sup>**

<sup>1</sup>*School of Engineering (UPV/EHU), Plaza Ingeniero Torres Quevedo 1, Bilbao 48013, Spain*

\*Corresponding author: laura.barrio@ehu.eus

### **Supplementary material**

#### **List of figures**

Figure S1. A schematic representation of control panel used for experiments. The abbreviations used are as follows: Pressure Indicator Controller (PIC), Pressure Indicator (PI), Temperature Indicator Controller (TIC)

Figure S2. CO<sub>2</sub>-TPD profiles of the prepared catalysts in 4% H<sub>2</sub>/Ar atmosphere and 10K/min heating rate

Figure S3. TEM micrographs of fresh and used catalyst, and SEM micrograph of deactivated catalyst of 13Ni/Al<sub>2</sub>O<sub>3</sub>

Figure S4. TEM and STEM micrographs of fresh and used catalyst and SEM micrograph of deactivated catalyst of 4Co-13Ni/Al<sub>2</sub>O<sub>3</sub>

Figure S5. TEM and STEM micrographs of fresh and used catalyst and SEM micrograph of deactivated catalyst of 4Cr-13Ni/Al<sub>2</sub>O<sub>3</sub>

Figure S6. TEM and STEM micrographs of fresh and used catalyst and SEM micrograph of deactivated catalyst of 4Fe-13Ni/Al<sub>2</sub>O<sub>3</sub>

Figure S7. TEM and STEM micrographs of fresh and used catalyst and SEM micrograph of deactivated catalyst of 4Mo-13Ni/Al<sub>2</sub>O<sub>3</sub>

Figure S8. TEM and STEM micrographs of fresh and used catalyst and SEM micrograph of deactivated catalyst of 8Mo-13Ni/Al<sub>2</sub>O<sub>3</sub>

Figure S9. STEM micrographs of used 4Co-13Ni/Al<sub>2</sub>O<sub>3</sub> catalyst.

Figure S10. Extension of methane activity curves obtained for alumina supported catalysts

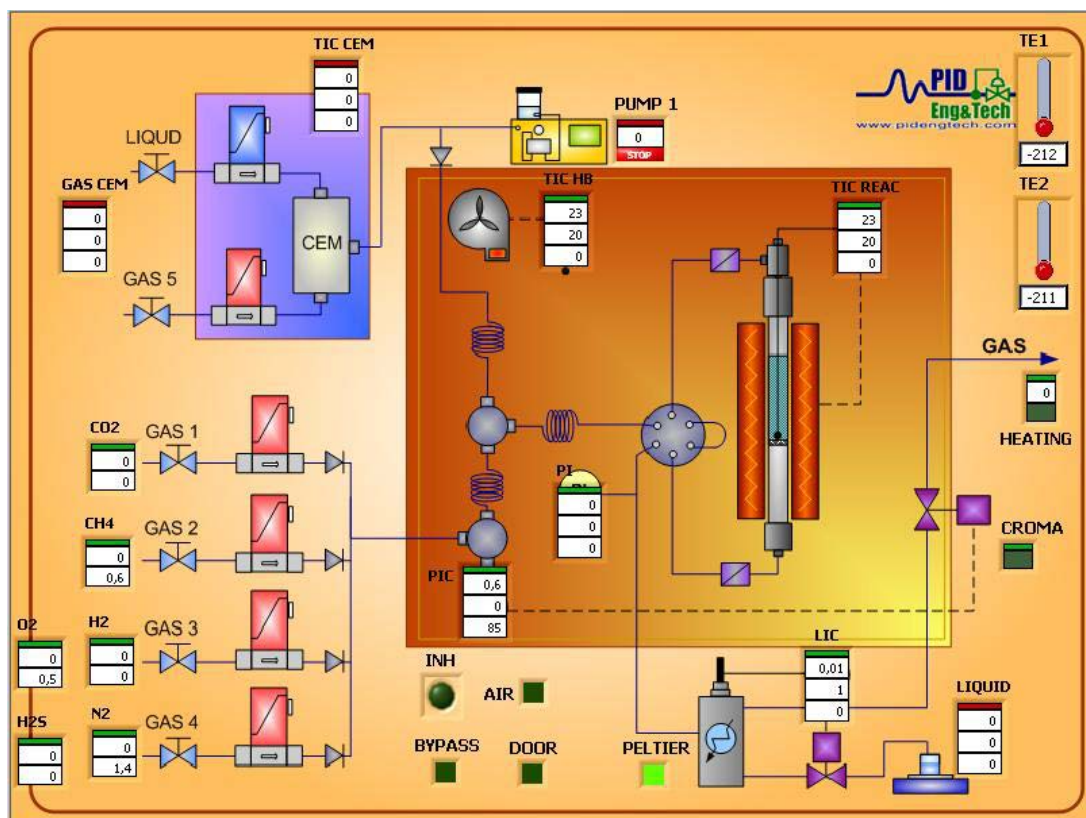


Figure S1. A schematic representation of control panel used for experiments. The abbreviations used are as follows: Pressure Indicator Controller (PIC), Pressure Indicator (PI), Temperature Indicator Controller (TIC)

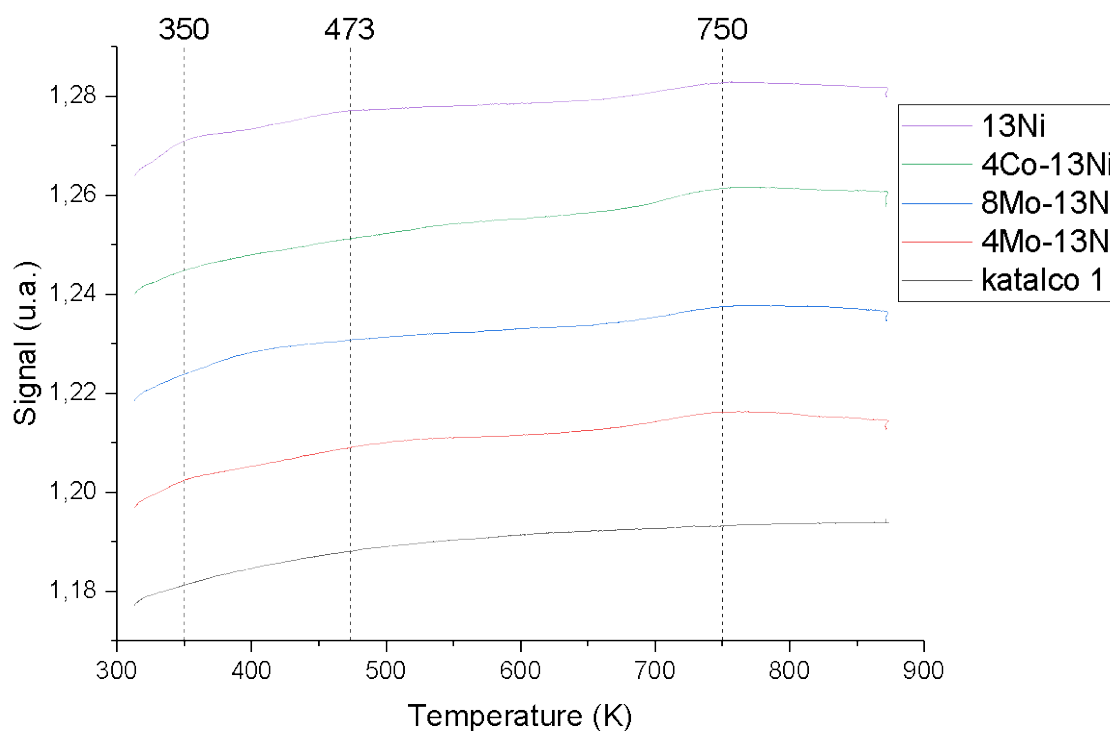


Figure S2. CO<sub>2</sub>-TPD profiles of the prepared catalysts in 4% H<sub>2</sub>/Ar atmosphere and 10K/min heating rate

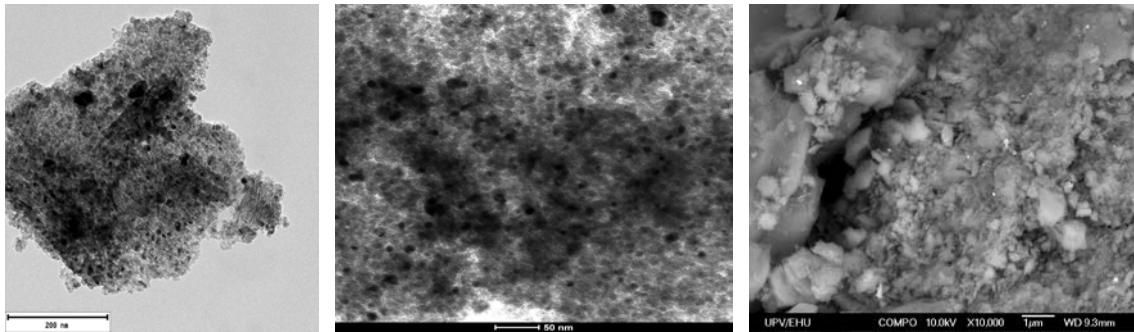


Figure S3. TEM micrographs of fresh and used catalyst, and SEM micrograph of deactivated catalyst of  $13\text{Ni}/\text{Al}_2\text{O}_3$

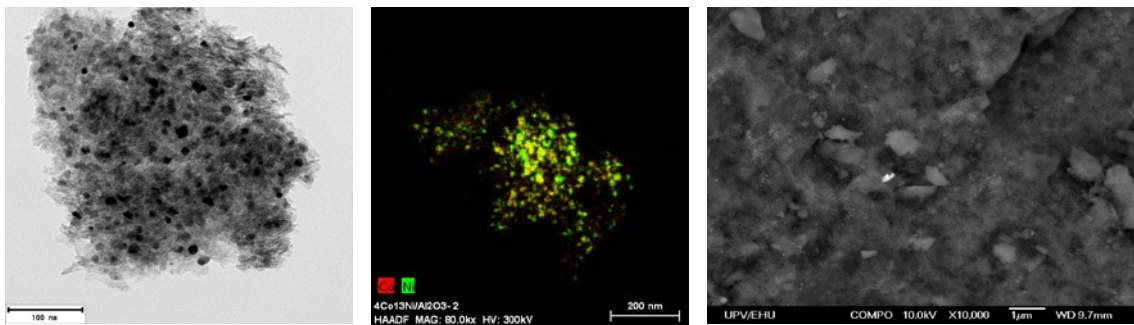


Figure S4. TEM and STEM micrographs of fresh and used catalyst and SEM micrograph of deactivated catalyst of  $4\text{Co}-13\text{Ni}/\text{Al}_2\text{O}_3$

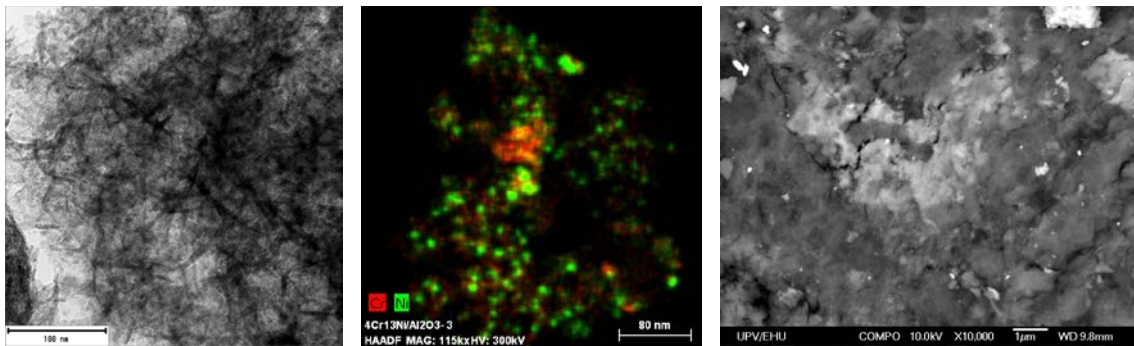


Figure S5. TEM and STEM micrographs of fresh and used catalyst and SEM micrograph of deactivated catalyst of  $4\text{Cr}-13\text{Ni}/\text{Al}_2\text{O}_3$

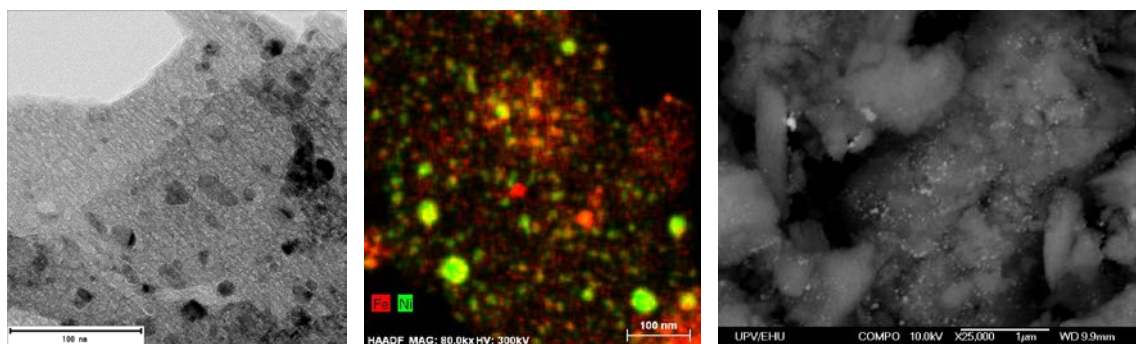


Figure S6. TEM and STEM micrographs of fresh and used catalyst and SEM micrograph of deactivated catalyst of 4Fe-13Ni/Al<sub>2</sub>O<sub>3</sub>

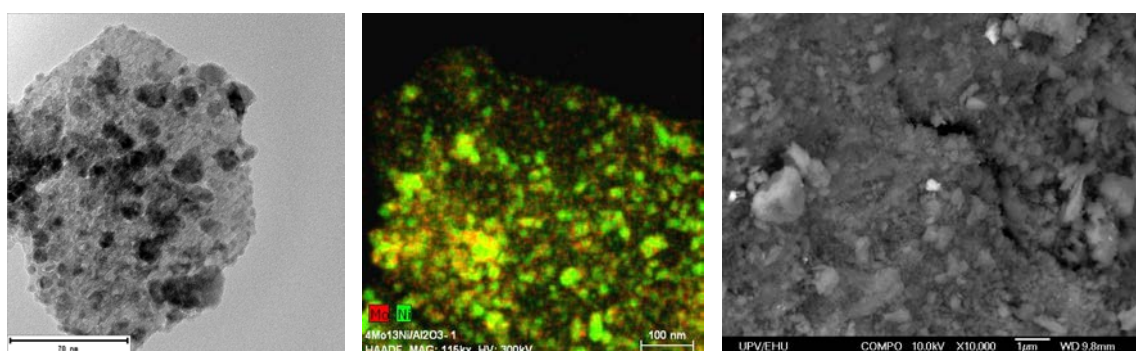


Figure S7. TEM and STEM micrographs of fresh and used catalyst and SEM micrograph of deactivated catalyst of 4Mo-13Ni/Al<sub>2</sub>O<sub>3</sub>

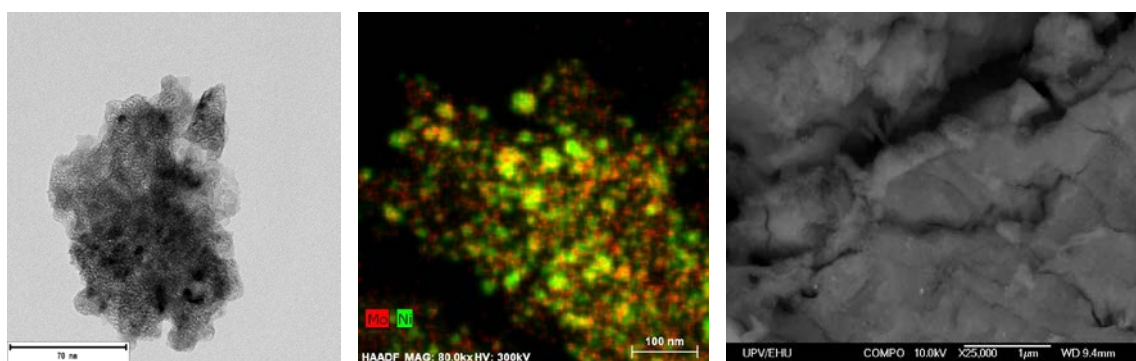


Figure S8. TEM and STEM micrographs of fresh and used catalyst and SEM micrograph of deactivated catalyst of 8Mo-13Ni/Al<sub>2</sub>O<sub>3</sub>

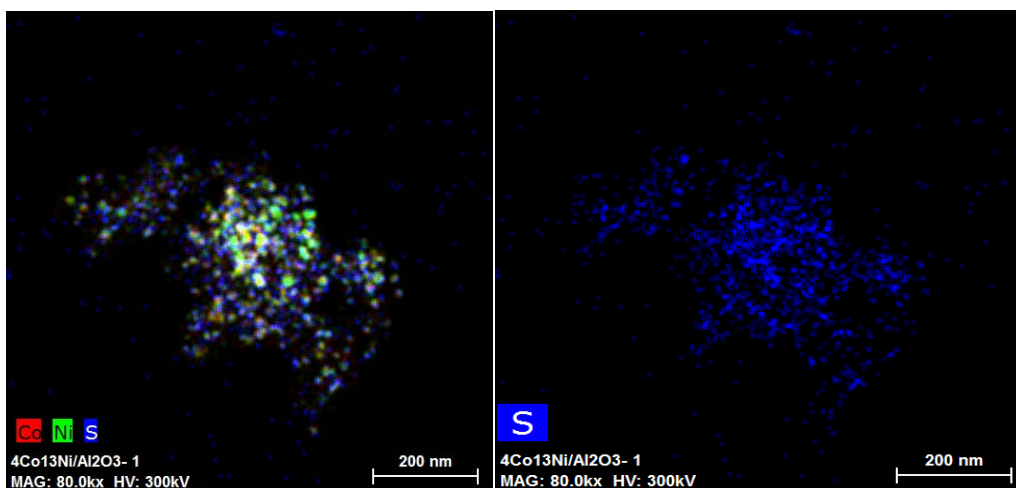


Figure S9. STEM micrographs of used 4Co-13Ni/Al<sub>2</sub>O<sub>3</sub> catalyst.

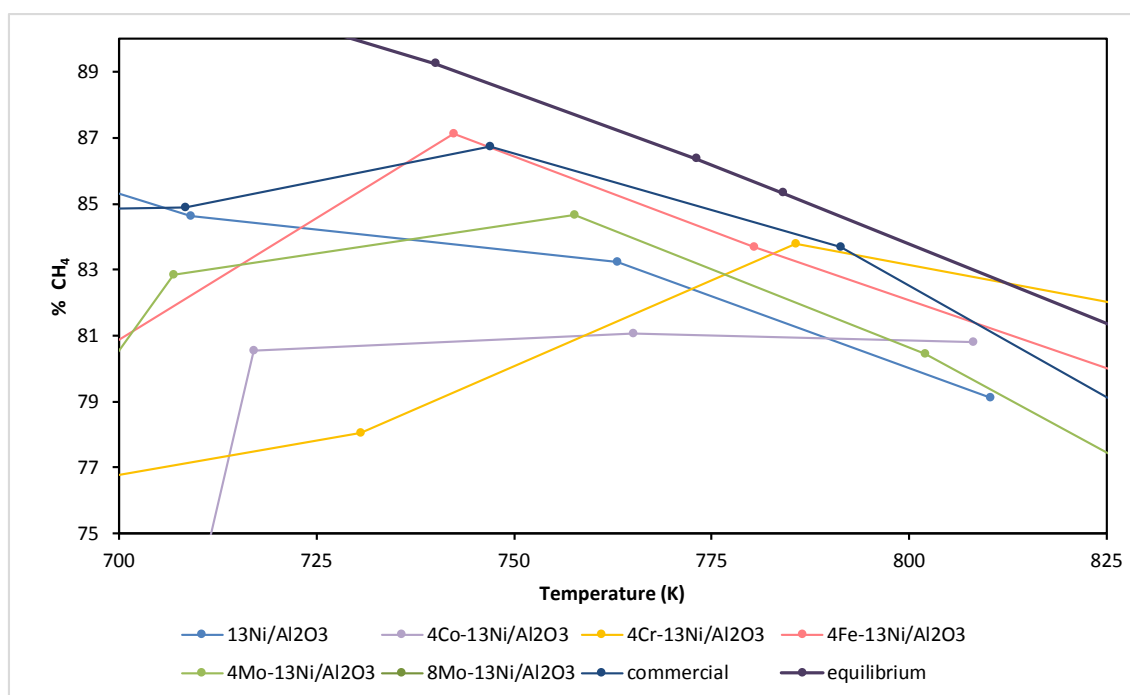


Figure S10. Extension of methane activity curves obtained for alumina supported catalysts