Can alkali and alkali-earth metals promote Ni/Zeolite catalysts performances towards CO_2 methanation?

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Supplementary material

Complementary information regarding purity and suppliers of the chemicals used in the synthesis of the catalysts from this work.

USY precursor	CBV 780, provided by Zeolyst company
Cesium precursor	$CsNO_3$, Sigma Aldrich, purity: ≥99 %
Nickel precursor	$Ni(NO_3)_2{\cdot}6H_2O$, Sigma Aldrich, purity: ≥98.5 %
Lithium precursor	$LiNO_3$, Sigma Aldrich, purity: ≥99 %
Potassium precursor	KNO_3, Sigma Aldrich, purity: ≥99 %
Magnesium precursor	$Mg(NO_3)_2{\cdot}6H_2O$, Sigma Aldrich, purity: ≥99 %
Calcium precursor	$Ca(NO_3)_2{\cdot}4H_2O$, Sigma Aldrich, purity: ≥99 %
2-Propanol	Scharlau, analytical grade

Complementary information regarding gases supplier and purity

All gases (for preparation, characterization and catalytic tests) were supplied by Air Liquide and presented purities ≥99.9990 %.

Complementary information regarding XRD analysis:

NiO (COD 1010381); Li_2O (COD 1010064); Li_2SiO_3 (COD 2310662); Li_2SiO_5 (COD 9007747); KO_2 (COD 1537125); MgO (COD 5000225); CaO (COD 1011095); $CaCO_3$ (COD 9009668).

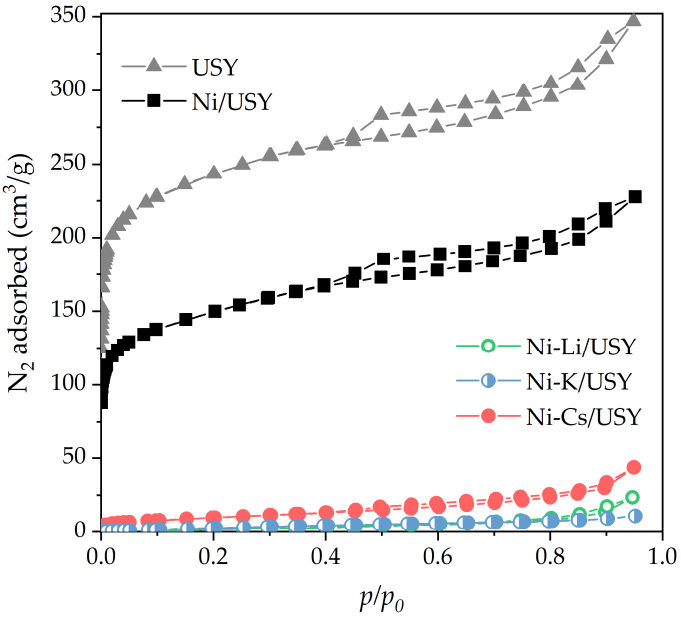

Figure S1. N_2 isotherms obtained for the Ni-A/USY catalysts after calcination.

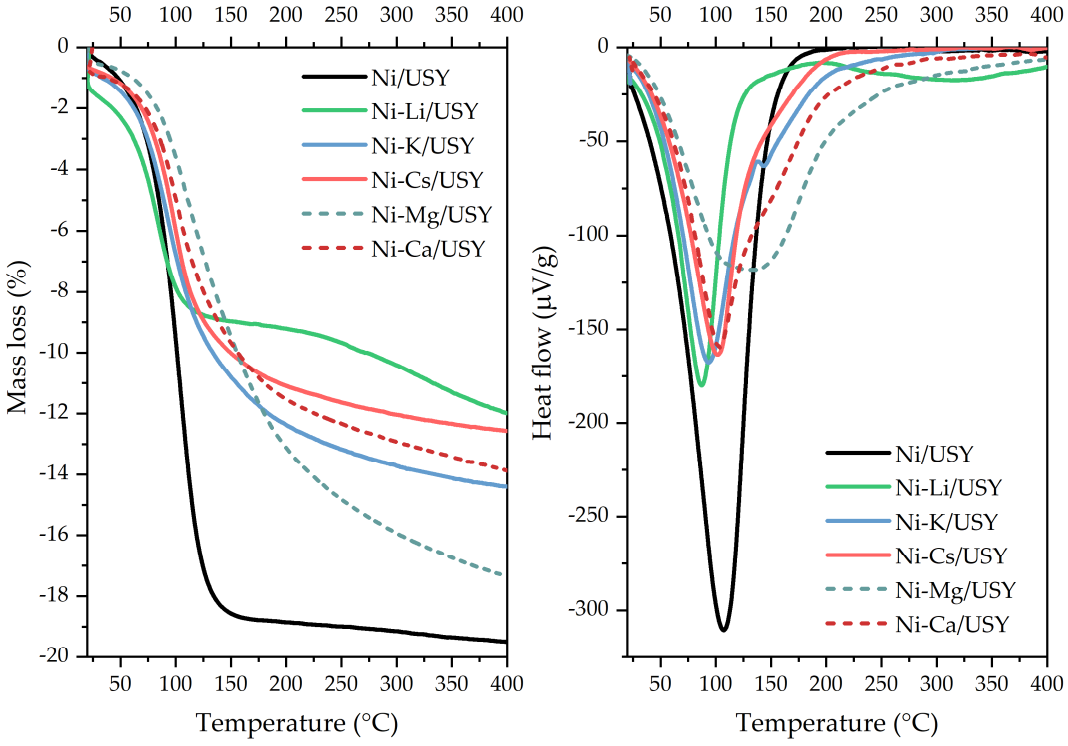

Figure S2. TGA results for Ni-A/USY and Ni-AE/USY catalysts after saturation with water.

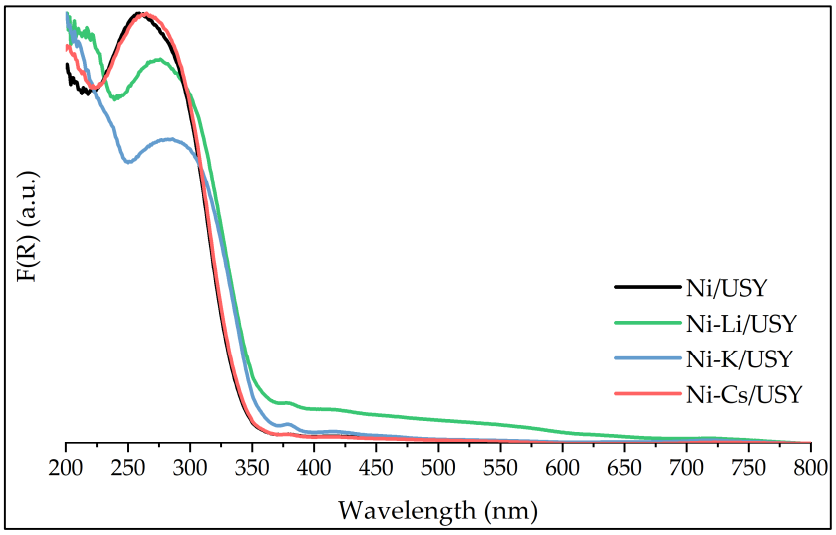

Figure S3. DRS UV-Vis spectra obtained for the Ni-A/USY catalysts after calcination.

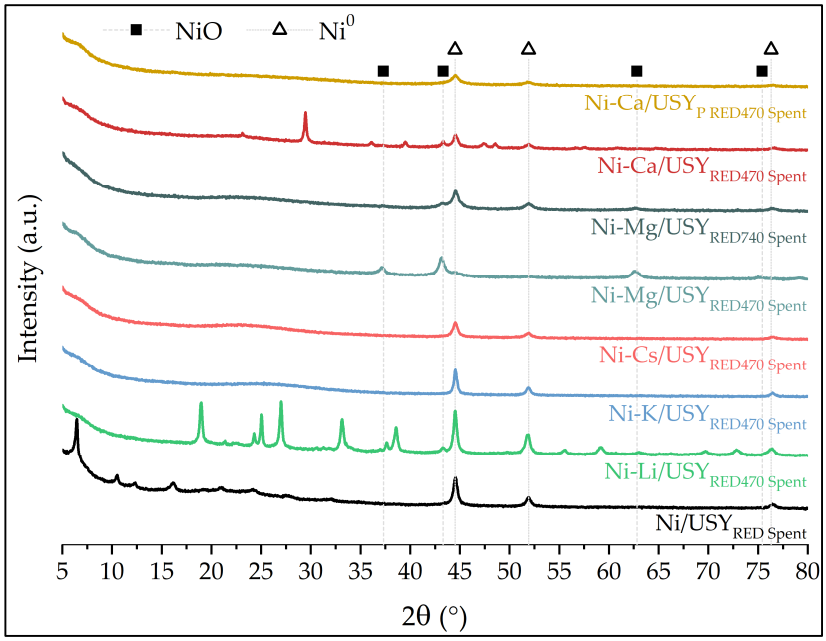

Figure S4. XRD patterns collected for all the catalysts from this work after catalytic tests.

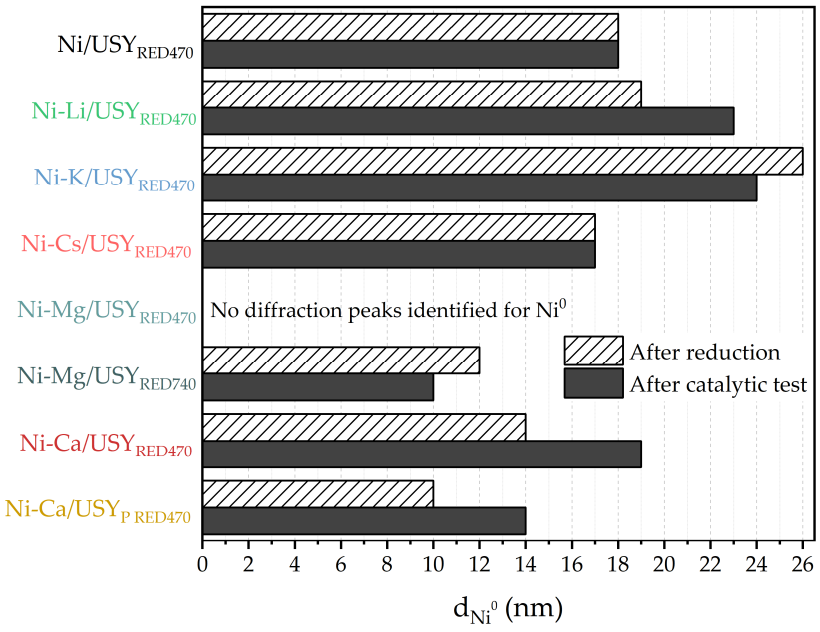

Figure S5. Ni⁰ crystallite sizes determined from XRD data and using Scherrer equation for all the catalysts from this work after reduction and catalytic tests.

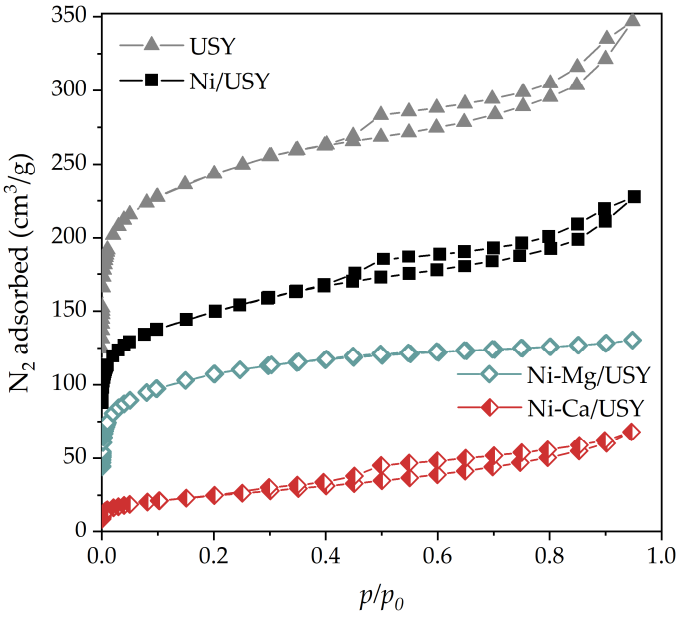

Figure S6. N_2 isotherms obtained for the Ni-AE/USY catalysts after calcination.

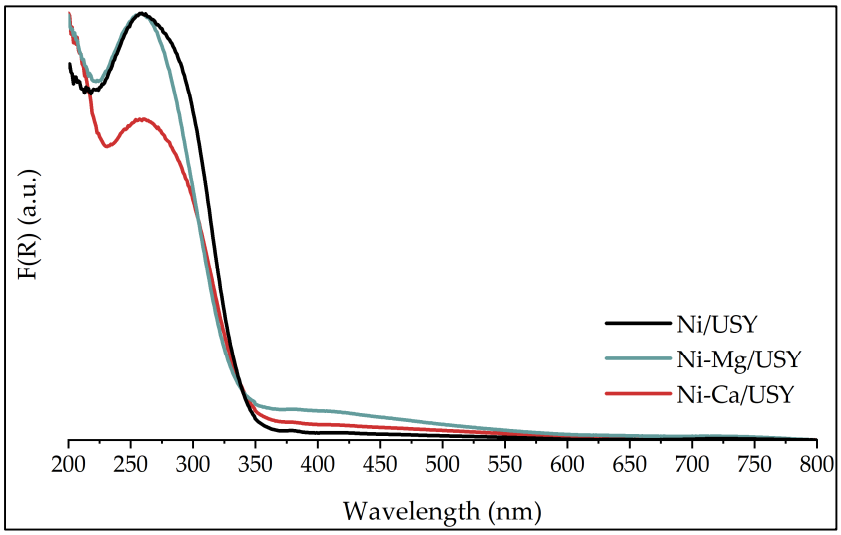

Figure S7. DRS UV-Vis spectra obtained for the Ni-AE/USY catalysts after calcination.

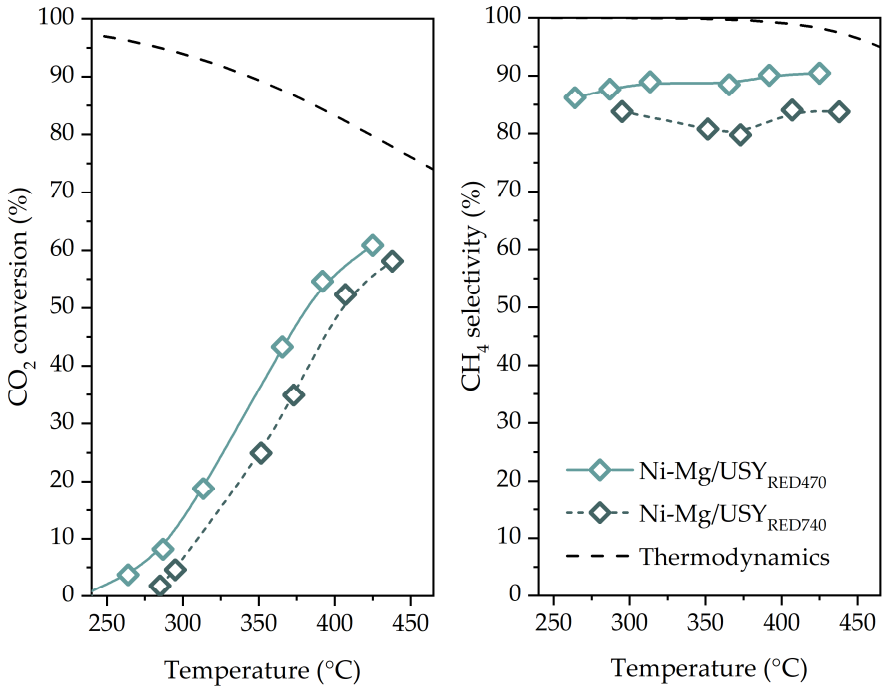

Figure S8. Effect of the pre-reduction temperature in the CO_2 conversion and CH_4 selectivity of Ni-Mg/USY catalyst. Operating conditions: 1 bar, 86 100 ml h^{-1} g_{cat}^{-1}, CO_2:H_2:N_2 = 9:36:10.

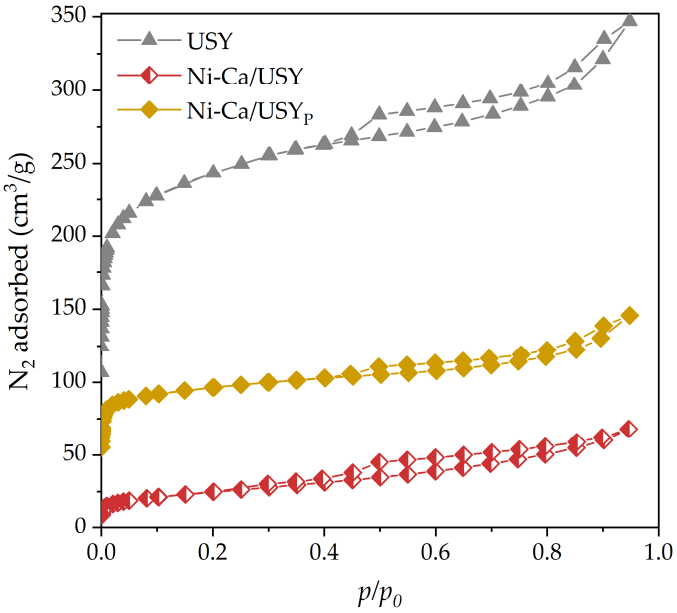

Figure S9. N_2 isotherms obtained for the Ni-Ca/USY and Ni-Ca/USY$_P$ catalysts after calcination.

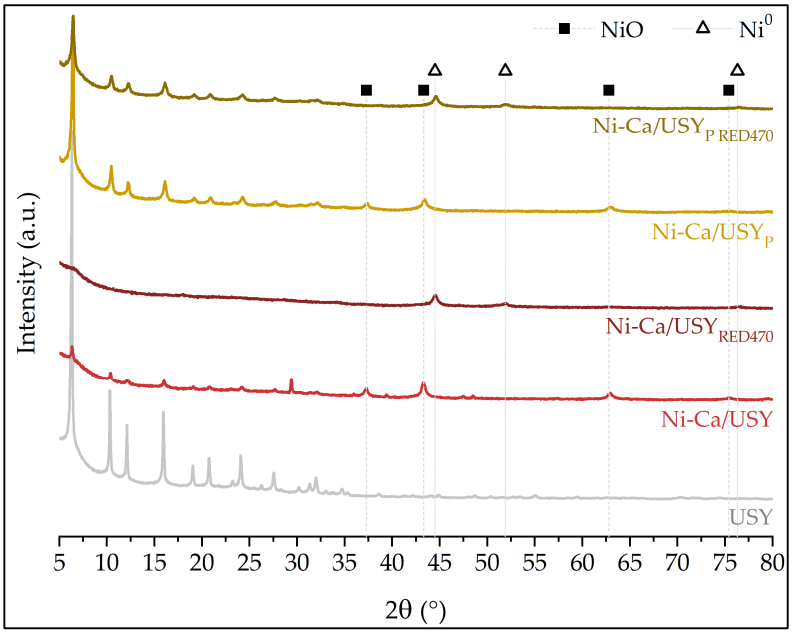

Figure S10. XRD patterns obtained for the Ni-Ca/USY and Ni-Ca/USY$_P$ catalysts after calcination and reduction.