

Supplementary data

Table S1. Calculated surface % area for the indicated elements obtained from XPS and peaks maxima for NiBaAlO, NiMgAlO and NiCaAlO samples

Percentage of indicated species for deconvolution of C1s and Ni2p XPS signals					
XPS Zone Sample	C1s-1 % (Carbonate)	C1s-2 % (Graphitic)	C1s-3 % (Carbide)	Ni2p-1% (Ni ²⁺)	Ni2p-2 % (Ni ⁰)
NiBaAlO	25.3	69	5.7	90.0	10.0
NiBaAlO-PRx	45.9	38.6	15.5	62.7	37.3
NiCaAlO	10.7	84.6	4.8	98.7	1.3
NiCaAlO-PRx	22.8	50.3	26.9	50.6	49.4
NiMgAlO	15.3	77	7.6	100.0	0.0
NiMgAlO-PRx	3.3	48.1	48.6	69.5	30.5

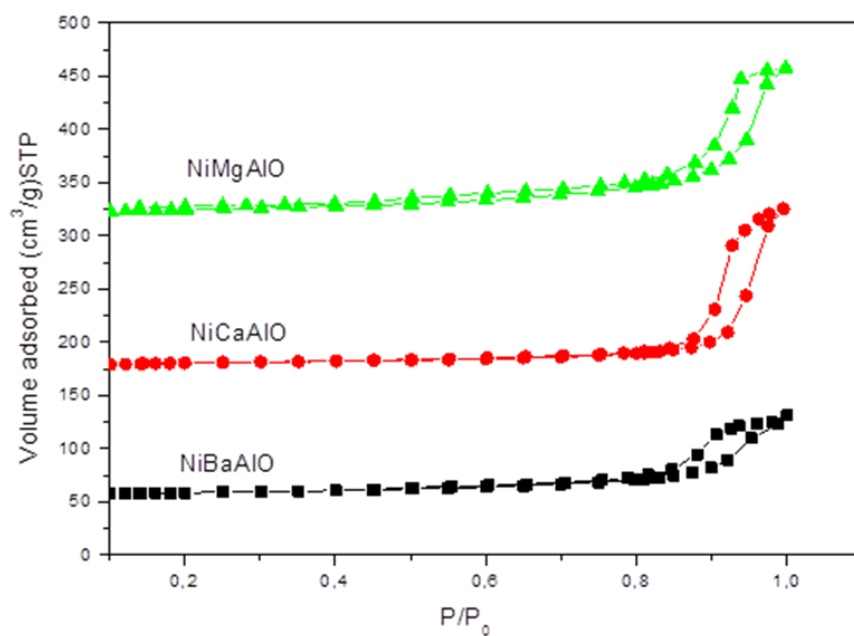


Fig. S1. Nitrogen adsorption–desorption isotherms of catalysts

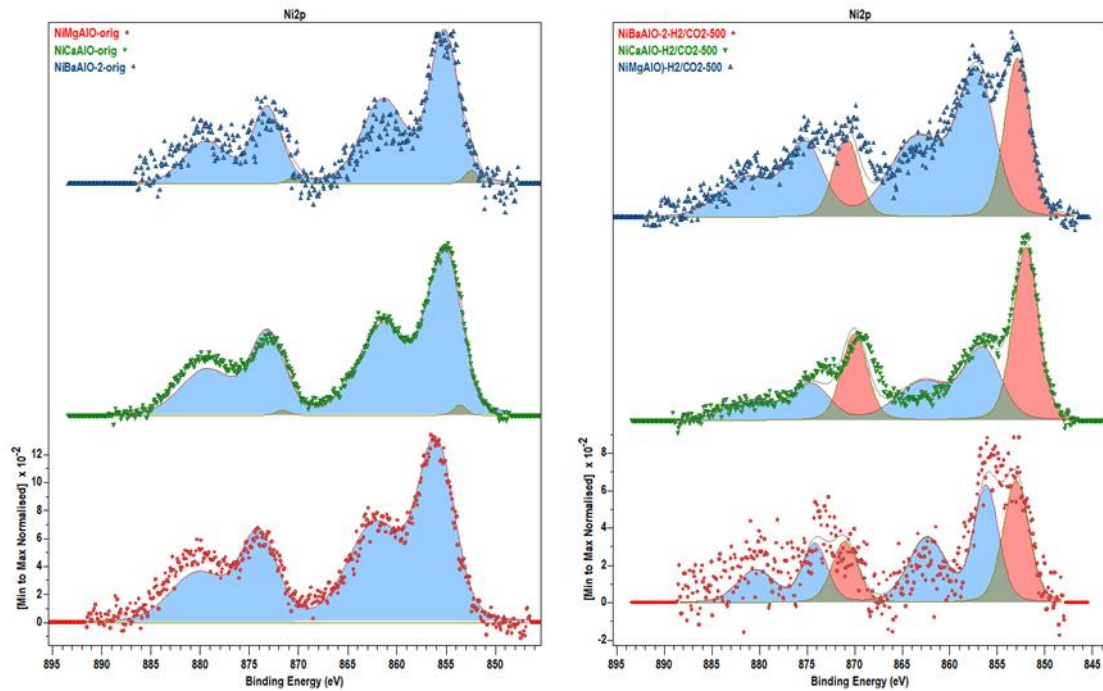


Fig. S2. Fitting of Ni2p XPS of orinal samples (left) and “in situ” treated samples after CO₂+H₂ reaction (right). Light blue component simulate NiO (Ni²⁺) and pink component simulate metallic nickel (Ni⁰)

Table S2. List of peak position and corresponding crystallographic planes for XRD patterns graphed on Figure 1 and Figure 7

Peaks located at 37.442°, 43.473°, 63.204°, 75.374° and 79.870° can be assigned to the (111), (200), (220), (311) and (222) planes of cubic phased and space group of Fm-3m respectively for NiO species (JCPDS, No. 00-001-1239). The XRD spectrum of the catalyst NiMgAlO also indicates the presence of the phase spinel of MgAl₂O₄, which is situated at 19.154°, 31.589°, 37.281°, 45.306°, 60.026°, 66.229°, 74.679°, and 78.306°, and may be ascribed to the (111), (220), (311), (400), (511), (620), and (622) planes of (JCPDS, No.00-001-157).

Peaks at 35.213°, 37.487°, 41.751°, 46.265°, 52.651°, 57.609°, 61.418°, 66.651°, 68.348° and 77.029°, which may be ascribed to the (112), (-110), (222), (020), (220), (020), (132), (-121), (130), (-211) and (343) planes of phased Rhombohedral and space group of R-3c (JCPDS, No.01-073-1512) and the BaAl₂O₄ side-phase .

Peaks located at 19.985°, 25.428°, 28.967°, 33.002°, 34.481°, 35.465°, 36.868°, 40.568°, 41.365°, 44.052°, 45.116°, 46.840°, 47.942°, 52.230°, 54.653°, 57.129°, 61.166°, 66.495°, 68.8311°, can be assigned of Monoclinic phase and space group: C2/c (JCPDS, NO.00-023-1037).

Peaks located at 44.497°, 51.851°, 76.383 correspond to (111), (200), and (220) planes of metallic Ni (JCPDS, No. 01-087-0712).