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Article

Development of Nanostructured Al_2O_3–TiO_2 Mixed Oxides as Supports for NiMoW Catalysts and Their Evaluation in 3-Methyl Thiophene Hydrodesulfurization

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Supplementary Information

Table S1. Crystal sizes and lattice parameters of the synthesized mixed oxides

Material	Tamaño de cristal [nm]	Sistema cristalino cúbico parámetros de red [Å] a
HAlTi-0.0	4.34	7.92
HAlTi-1.6	4.36	7.86
HAlTi-2.0	4.75	7.90
HAlTi-2.4	4.59	7.89

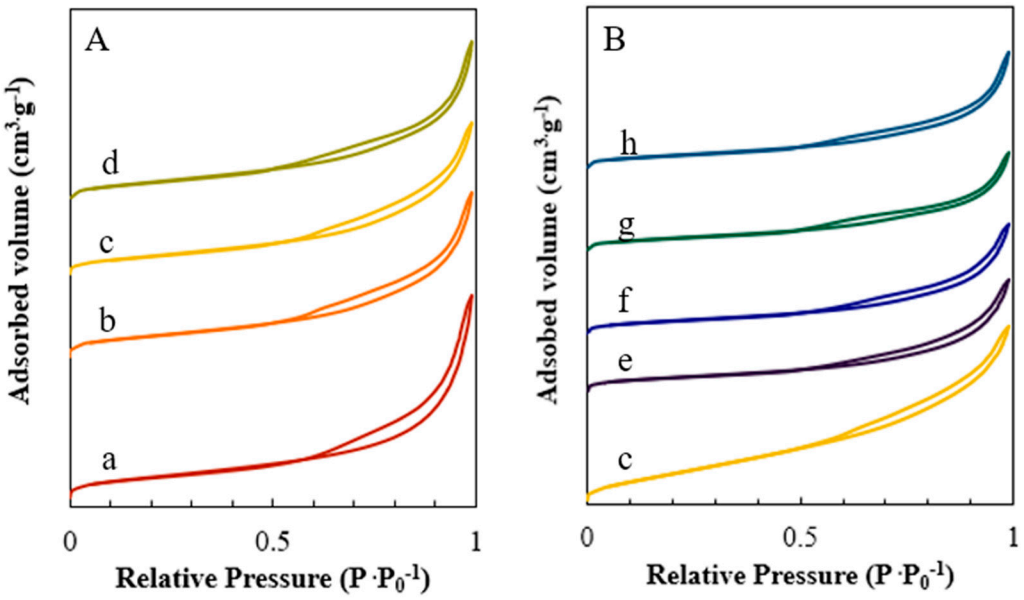


Figure S1. A) N2 adsorption–desorption isotherms for the mixed oxides (a) HAlTi-0.0, (b) HAlTi-1.6, (c) HAlTi-2.0, (d) HAlTi-2.4. B) N2 adsorption–desorption

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isotherms for the catalysts (c) HAlTi-2.0, (e) NiMoW0-HAlTi-2.0, (f) NiMoW5-HAlTi-2.0, (g) NiMoW10-HAlTi-2.0, (h) NiMoW15-HAlTi-2.0.

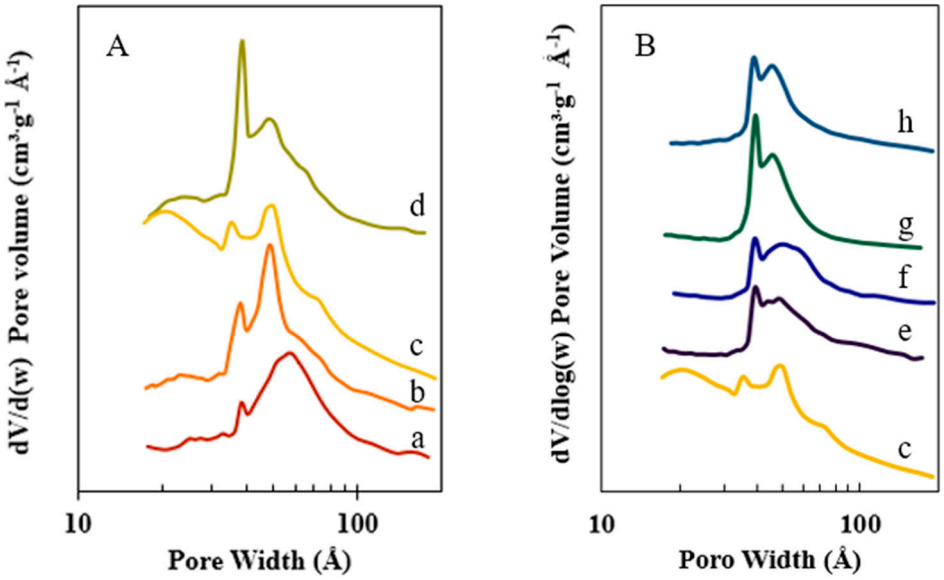


Figure S2. A) Pore size distributions for all the mixed oxides: (a) HAlTi-0.0, (b) HAlTi-1.6, (c) HAlTi-2.0, and (d) HAlTi-2.4. B) Pore size distributions for all the catalysts: (c) HAlTi-2.0, (e) NiMoW0-HAlTi-2.0, (f) NiMoW5-HAlTi-2.0, (g) NiMoW10-HAlTi-2.0, and (h) NiMoW15-HAlTi-2.0.

Table S2. Semiquantitative EDS analysis and nominal percentages of the materials.

Material	% Atomic experimental EDS			Nominal Atomic %		
	O	Al	Ti	O	Al	Ti
HAlTi-0.0	60	40	-	60.0	40.0	-
HAlTi-1.6	61.56	30.63	7.81	61.8	29.1	9.1
HAlTi-2.0	61.6	30.41	7.99	61.5	30.8	7.7
HAlTi-2.4	61.34	31.95	6.71	61.3	32	6.7

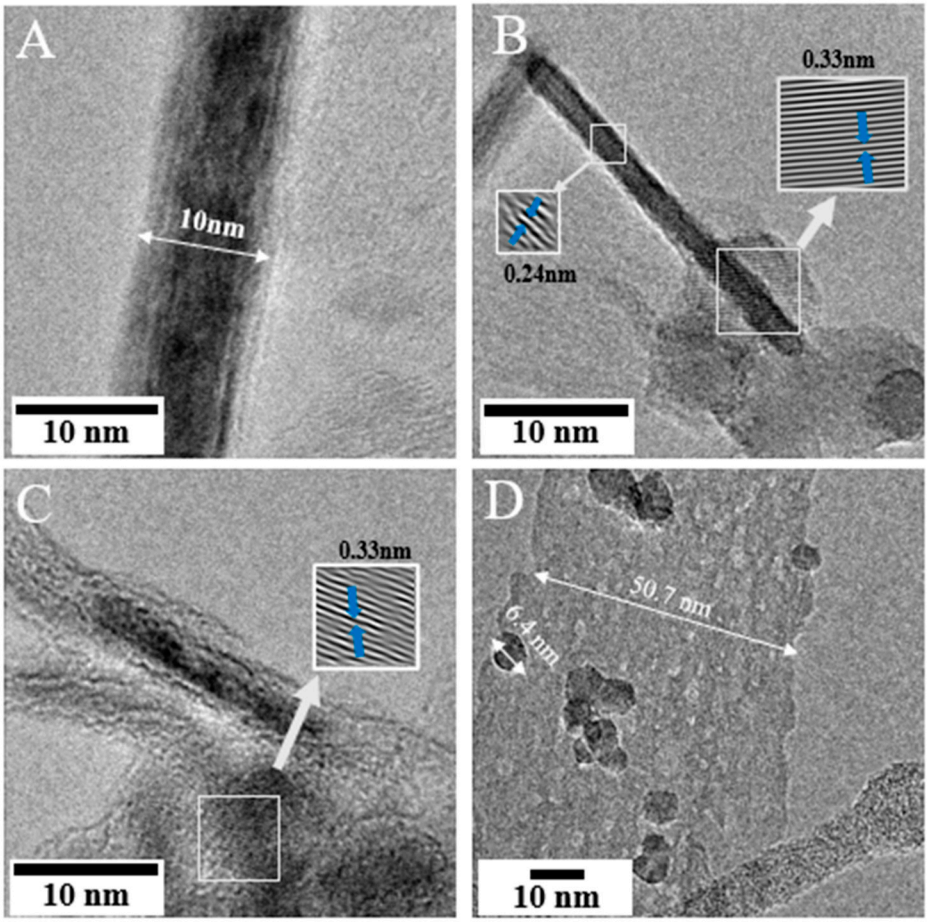


Figure S3. HRTEM micrographs for (A) HAlTi-1.6, (B) HAlTi-2.0, (C) y (D) HAlTi-2.4.

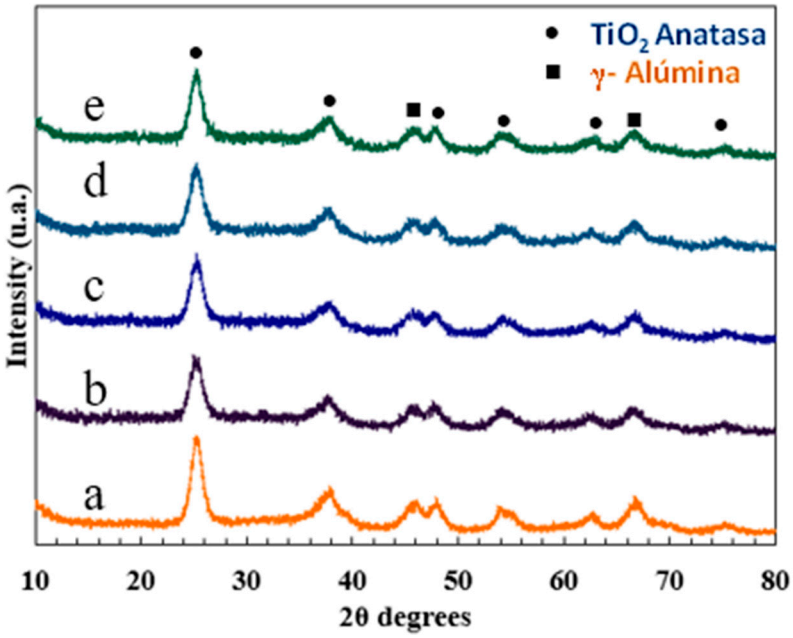


Figure S4. XRD diffractograms of the catalysts (a) HAlTi-2.0, (b) NiMoW0-HAlTi-2.0, (c) NiMoW5-HAlTi-2.0, (d) NiMoW10-HAlTi-2.0, and (e) NiMoW15-HAlTi-2.0.

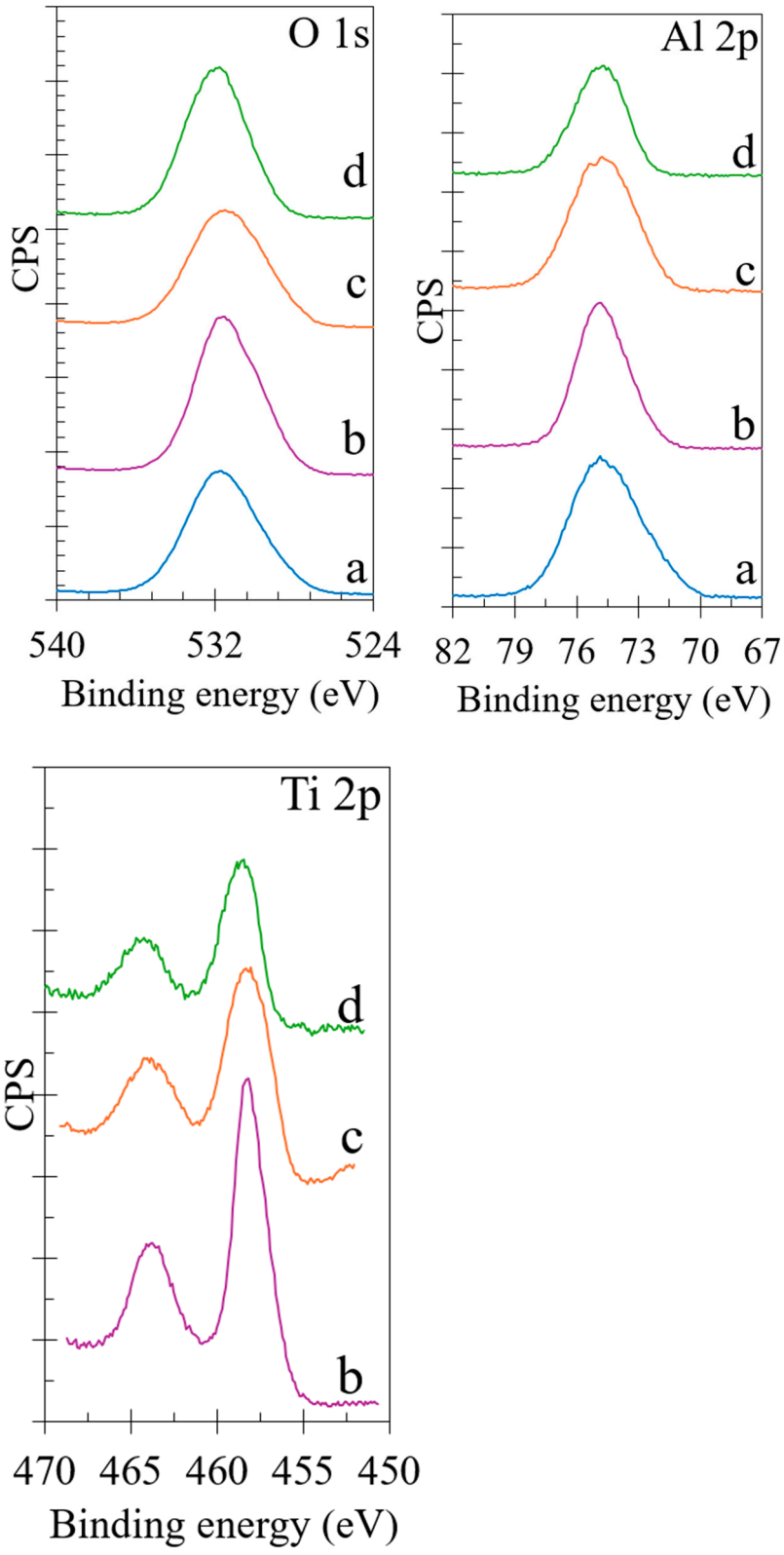
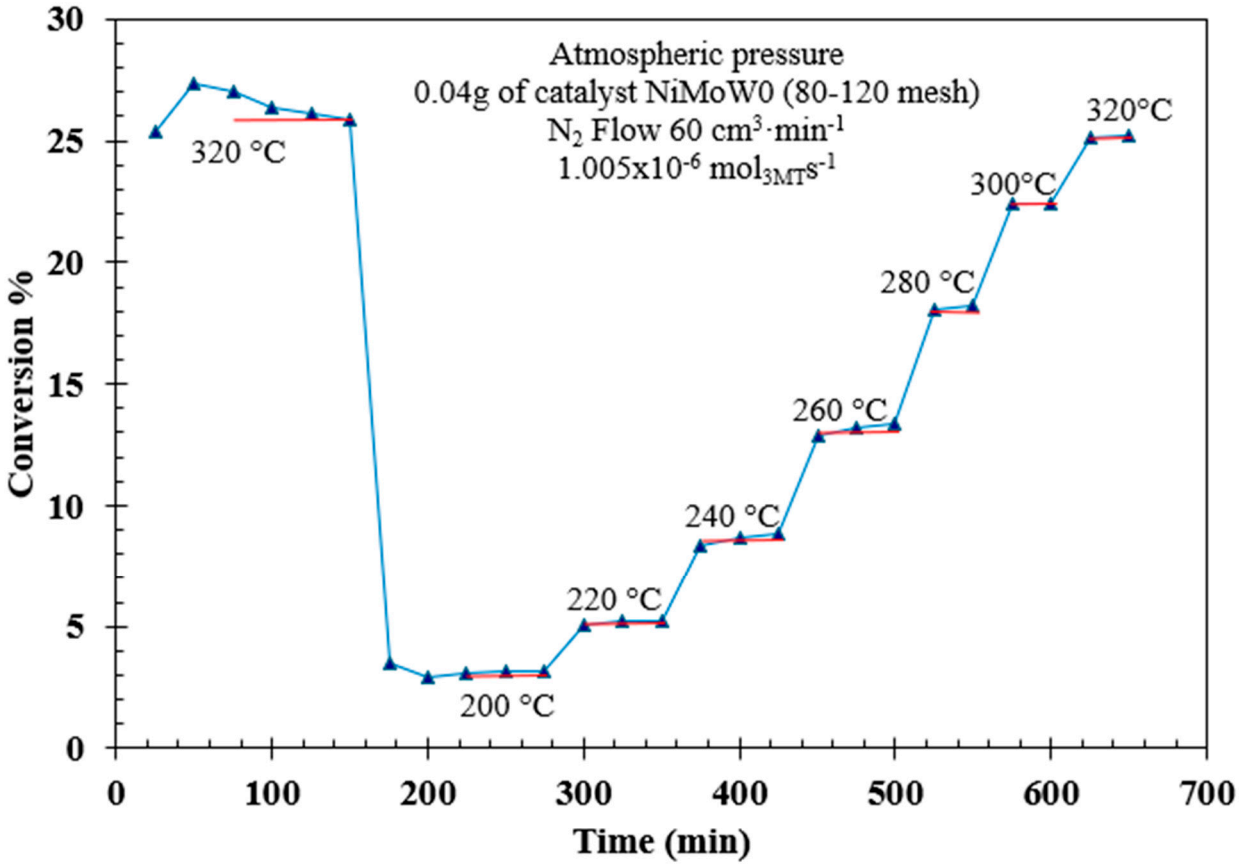
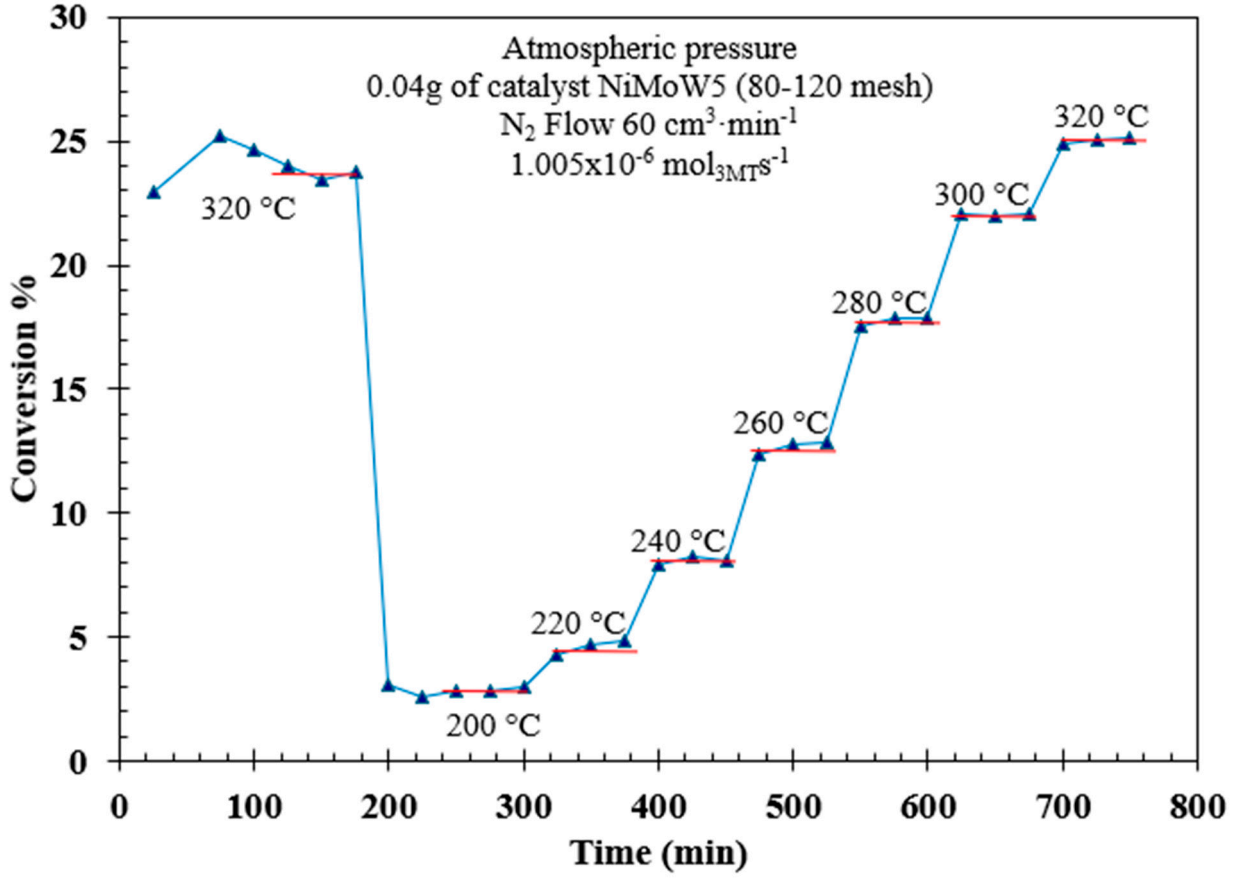
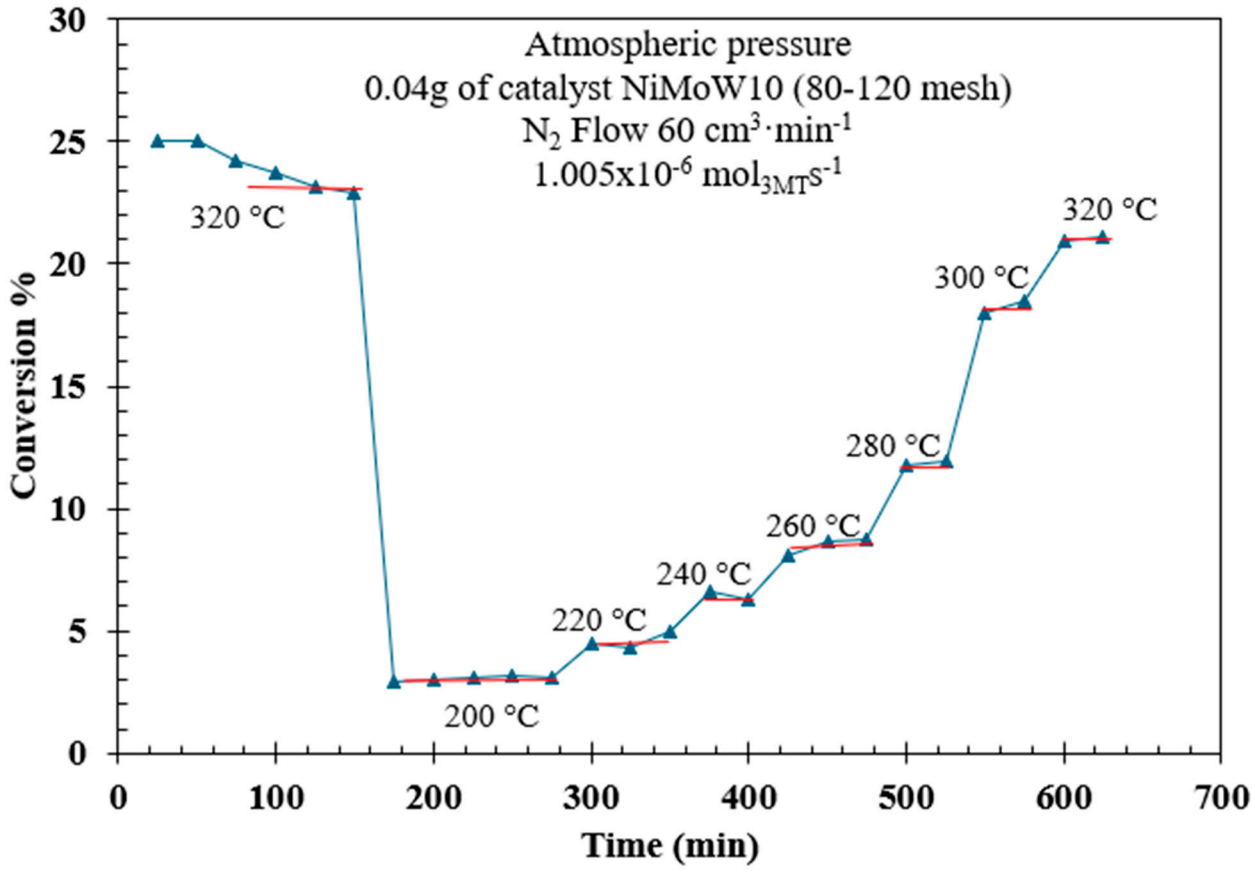


Figure S5. XPS spectra in the high-resolution windows of O 1s, Al 2p, and Ti 2p for all the samples. (a) HAlTi-0.0, (b) HAlTi-1.6, (c) HAlTi-2.0, and (d) HAlTi-2.4.


Atmospheric pressure
0.04g of catalyst NiMoW0 (80-120 mesh)
N2 Flow 60 cm3·min-1
1.005x10-6 mol3MTs-1
320 °C
200 °C
220 °C
240 °C
260 °C
280 °C
300°C
320°C
Conversion %
Time (min)
0
5
10
15
20
25
30
0
100
200
300
400
500
600
700


Atmospheric pressure
0.04g of catalyst NiMoW5 (80-120 mesh)
N2 Flow 60 cm3·min-1
1.005x10-6 mol3MTs-1
320 °C
200 °C
220 °C
240 °C
260 °C
280 °C
300 °C
320 °C
Conversion %
Time (min)
0
5
10
15
20
25
30
0
100
200
300
400
500
600
700
800



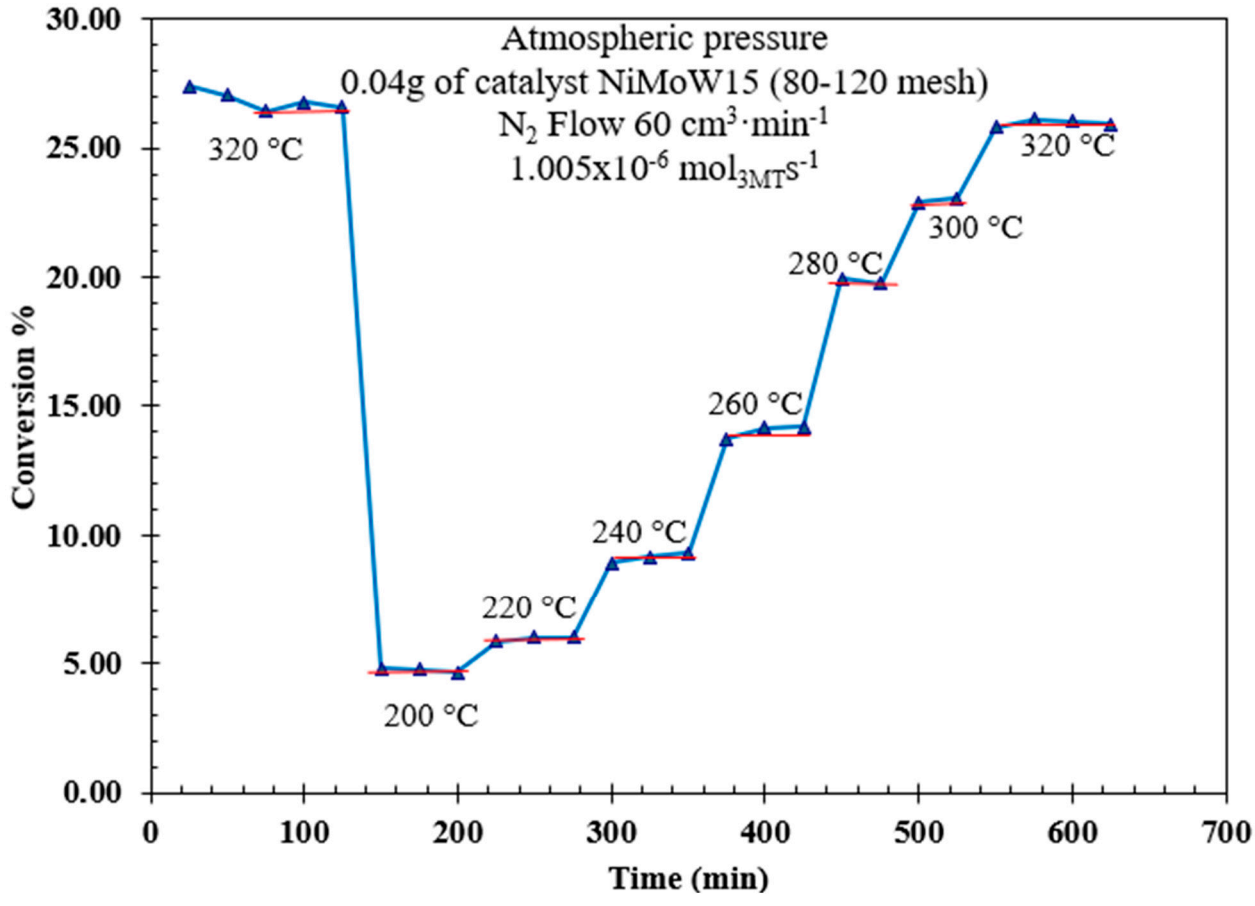


Figure S6. Conversion percentages of 3-Methyl Thiophene for catalysts HAlTi-0.0, HAlTi-1.6, HAlTi-2.0, and HAlTi-2.4.