Methanol Promoted Oxidation of Nitrogen Oxide (NO_x) by Encapsulated Ionic Liquids (ENILs)

Rubén Santiago[1], Susanne Mossin[2], Jorge Bedia[1], Rasmus Fehrmann[2], and José Palomar[1]

[1]*Chemical Engineering Department. Universidad Autónoma de Madrid. 28049 Madrid. Spain*

[2]*Centre for Catalysis and Sustainable Chemistry, Department of Chemistry, Technical University of Denmark, DK-2800 Kgs. Lyngby (Denmark).*

Supporting Information

Table S1: Elemental composition characterization of ENIL materials involved in the work 5

Figure S1: Pore size distribution of the materials involved in the work. 3

Figure S2: N_2 adsorption/desorption isotherms @ 77 K of all the materials involved in the work. 4

Figure S3: UV-Vis Spectrum of hollow carbon capsules (C_{Cap}) in dry conditions at different oxygen contents. Gas composition: 2,000 ppm NO, 6.3, 10.5 and 16.8% O_2, balance N_2, Flow: 200 mL·min^{-1}, GHSV=10,000 h^{-1}. Experiments conducted at room temperature. 6

Figure S4: UV-Vis Spectrum of 40% [bmim][NO_3] ENIL material (40% ENIL) in dry and 10% Relative Humidity conditions. Gas composition: 2,000 ppm NO, 10.5% O_2, balance N_2, Flow: 200 mL·min^{-1}, GHSV=10,000 h^{-1}. Experiments conducted at room temperature. 7

Figure S5: UV-Vis Spectrum of 20% [bmim][NO_3] ENIL material (20% ENIL) in 50% Relative Humidity and 800 ppm of MeOH conditions. Gas composition: 2,000 ppm NO, 10.5% O_2, balance N_2, Flow: 200 mL·min^{-1}, GHSV=10,000 h^{-1}. Experiments conducted at room temperature. 8

Figure S6: TGA analysis of the materials used in this work: hollow carbon capsules (C_{cap}) and ENIL materials with four different IL loads (20, 40, 60 and 80 % of [bmim][NO_3])

after being used in the catalytic reactions. Analysis carried out with a temperature increase of 10 ºC·min^{-1} under 50 mL·min^{-1} of N_2. 9

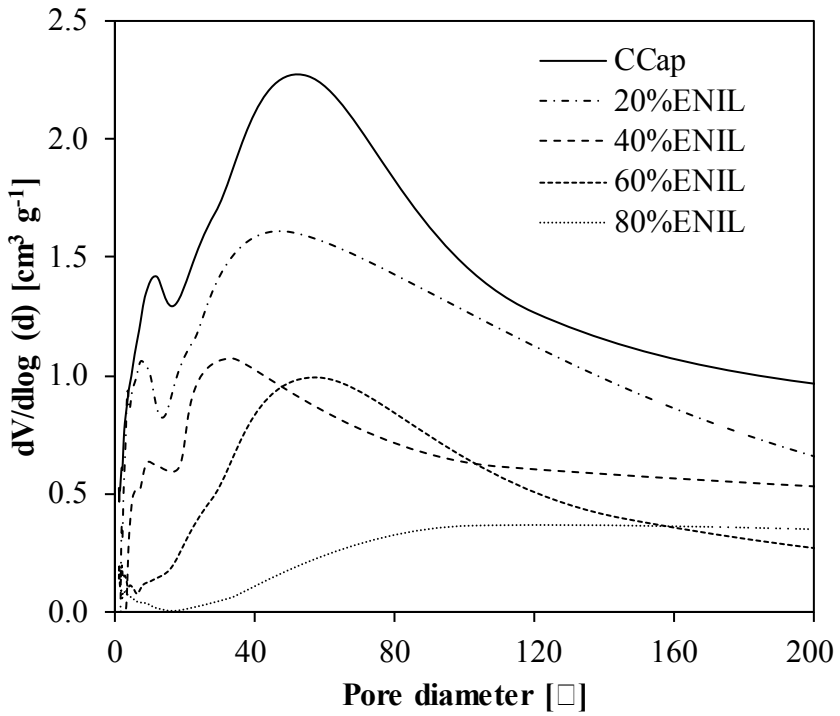

Figure S1: Pore size distribution of the materials involved in the work.

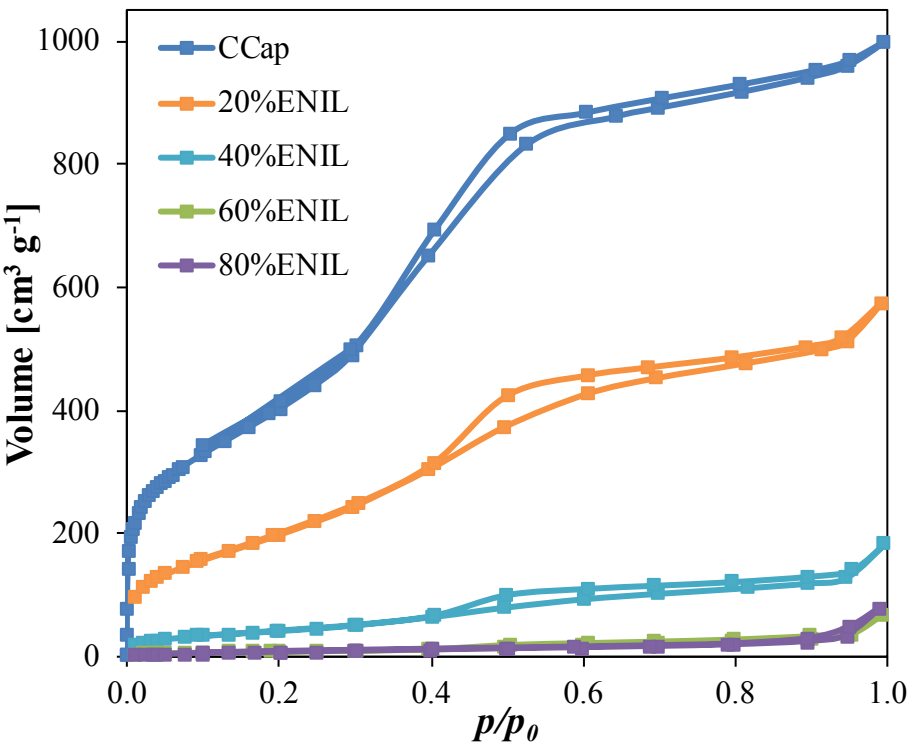

Figure S2: N_2 adsorption/desorption isotherms @ 77 K of all the materials involved in the work.

Table S1: Elemental composition characterization of ENIL materials involved in the work

		20% ENIL	40% ENIL	60% ENIL	80% ENIL
EA	**%C**	81.75	73.86	61.91	53.70
	%H	3.33	3.74	5.83	6.85
	%N	4.18	7.65	11.93	15.66
%IL	**EA**	20.03	36.65	57.16	75.04
	TGA	20.31	35.74	56.14	76.54
BET Area (m^2/g)		761	159	33	< 5
Average pore diameter (Å)		45.41	38.33	49.68	--

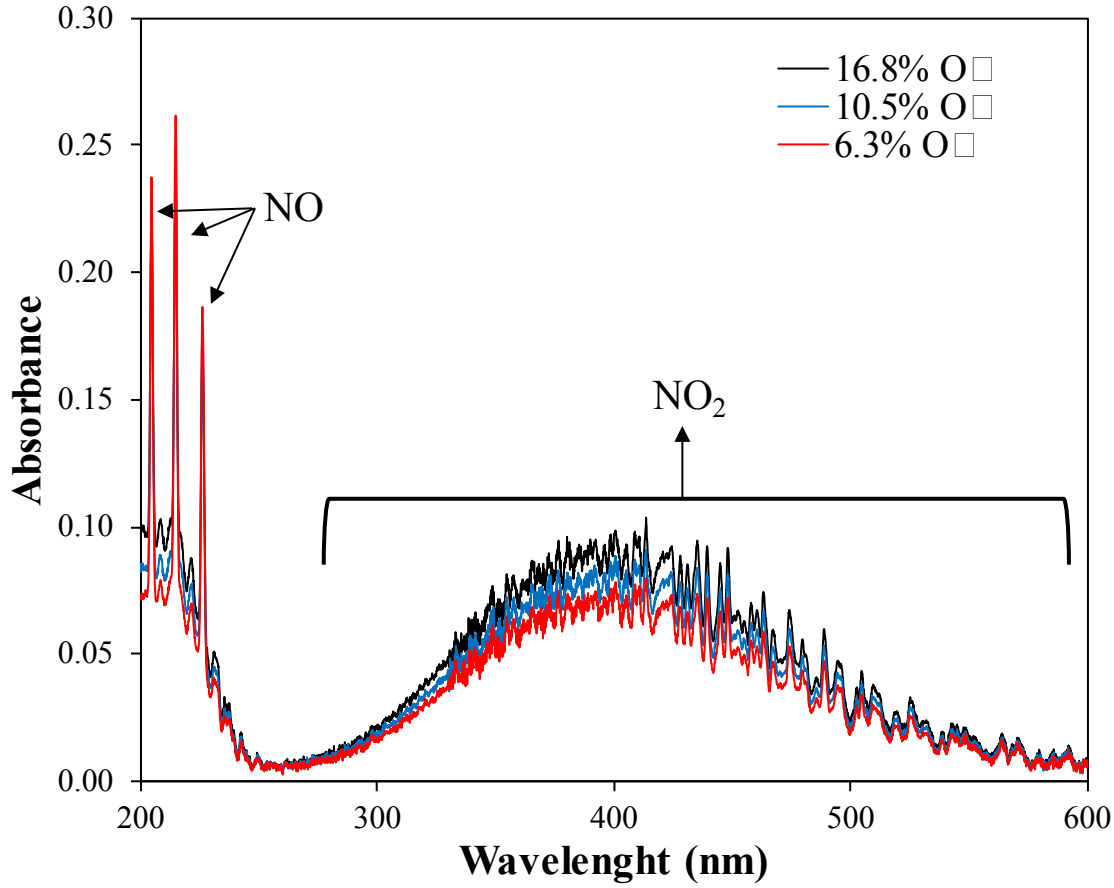

Figure S3: UV-Vis Spectrum of hollow carbon capsules (C_{Cap}) in dry conditions at different oxygen contents. Gas composition: 2,000 ppm NO, 6.3, 10.5 and 16.8% O_2, balance N_2, Flow: 200 mL·min^{-1}, GHSV=10,000 h^{-1}. Experiments conducted at room temperature.

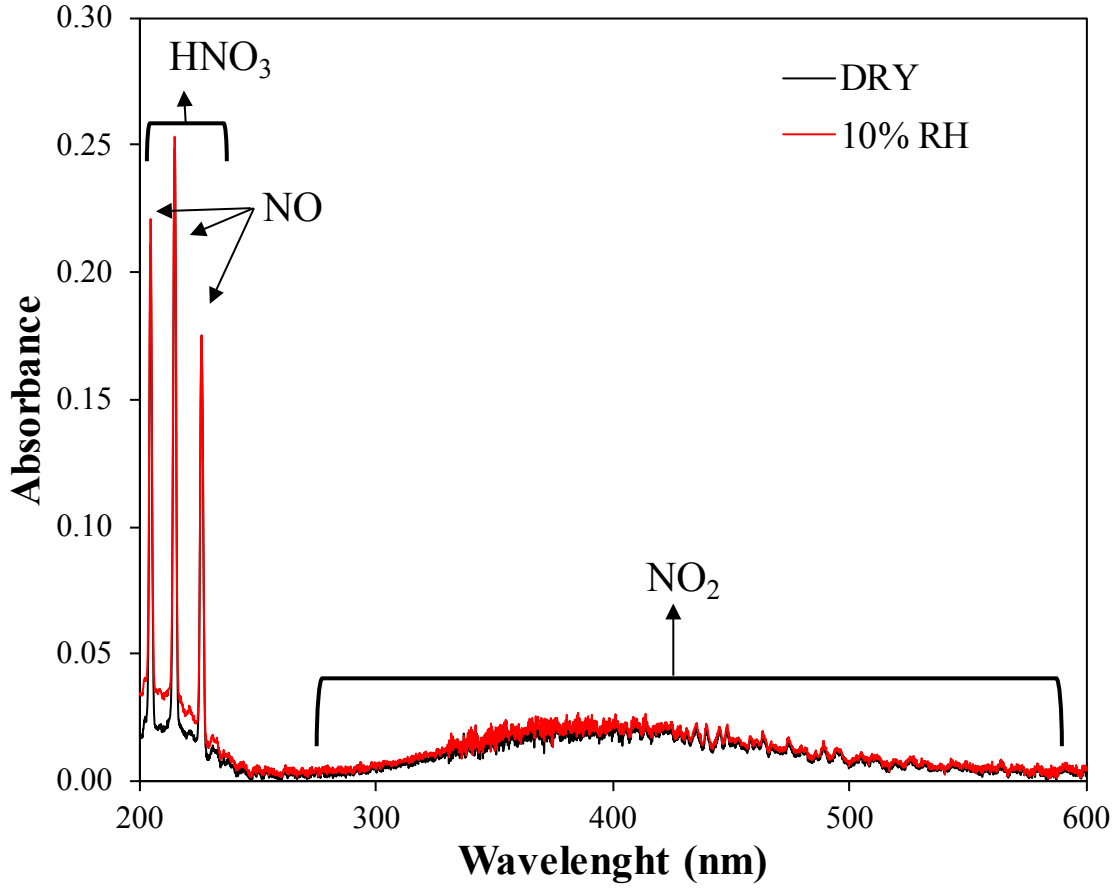

Figure S4: UV-Vis Spectrum of 40% [bmim][NO_3] ENIL material (40% ENIL) in dry and 10% Relative Humidity conditions. Gas composition: 2,000 ppm NO, 10.5% O_2, balance N_2, Flow: 200 mL·min^{-1}, GHSV=10,000 h^{-1}. Experiments conducted at room temperature.

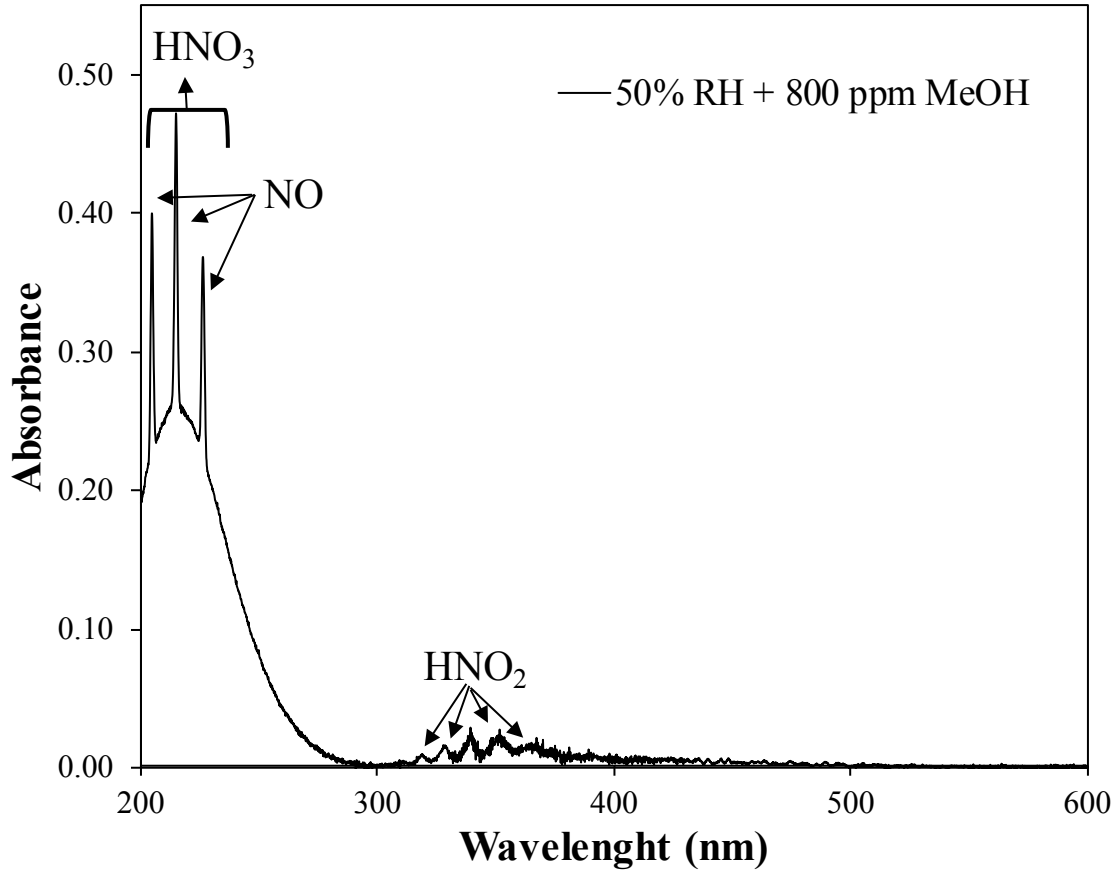

Figure S5: UV-Vis Spectrum of 20% [bmim][NO_3] ENIL material (20% ENIL) in 50% Relative Humidity and 800 ppm of MeOH conditions. Gas composition: 2,000 ppm NO, 10.5% O_2, balance N_2, Flow: 200 mL·min^{-1}, GHSV=10,000 h^{-1}. Experiments conducted at room temperature.

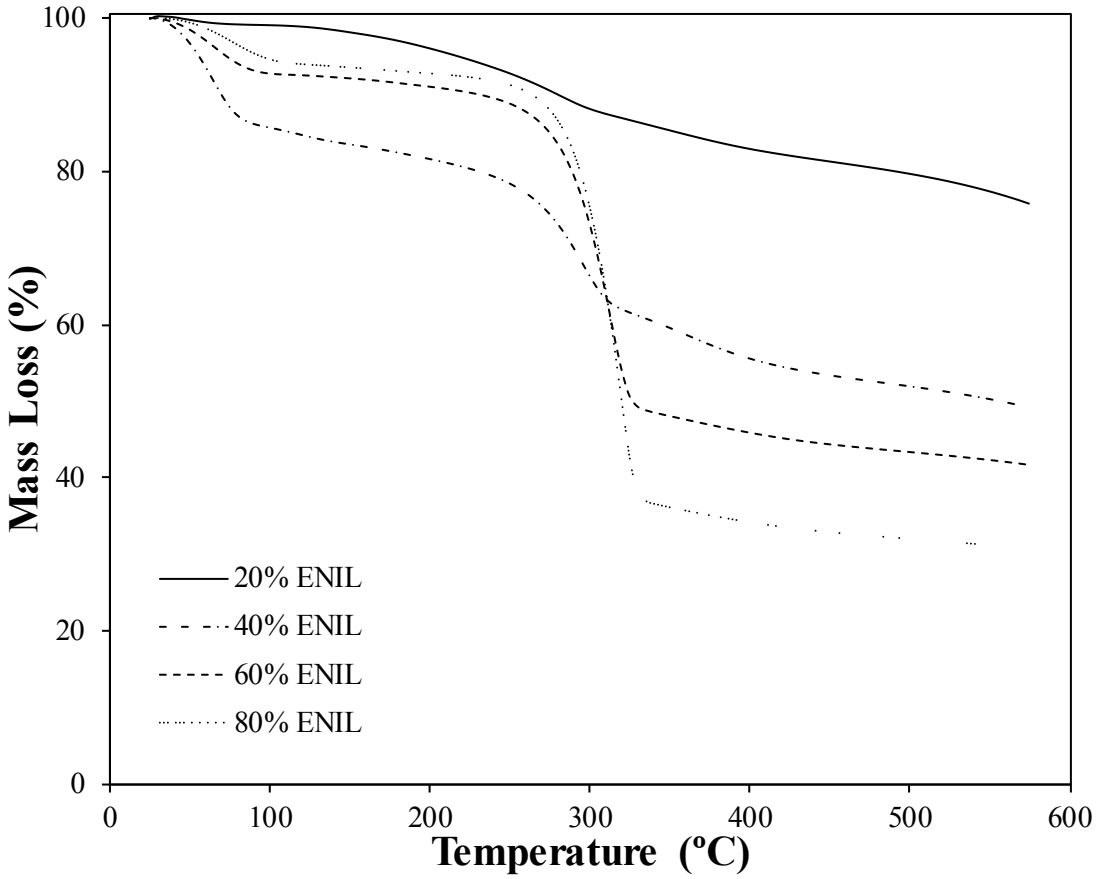

Figure S6: TGA analysis of the materials used in this work: hollow carbon capsules (C_{cap}) and ENIL materials with four different IL loads (20, 40, 60 and 80 % of [bmim][NO_3]) after being used in the catalytic reactions. Analysis carried out with a temperature increase of 10 ºC·min^{-1} under 50 mL·min^{-1} of N_2.