

“PdO vs. PtO” – The Influence of PGM Oxide Promotion of Co₃O₄ Spinel on Direct NO Decomposition Activity

Gunugunuri K. Reddy *, Torin C. Peck and Charles A. Roberts *

Toyota Research Institute of North America, Ann Arbor, MI 48105, USA; torin.peck@toyota.com

* Correspondence: krishna.gunugunuri@toyota.com (G.K.R.); charles.roberts@toyota.com (C.A.R.)

Supporting Information

Table 1. NO conversion, N₂, N₂O, NO₂ ppm values of the Co₃O₄ and various PdO/Co₃O₄ catalysts in the temperature region 400 – 650 °C.

NO conversion

Catalyst	Reaction Temperature			
	400 °C	450 °C	550 °C	650 °C
Co ₃ O ₄	3.15	2.27	1.85	0.74
1Pd/Co ₃ O ₄	2.6	3.2	3.08	16.21
2Pd/Co ₃ O ₄	2.86	3.32	3.4	19.1
3Pd/Co ₃ O ₄	2.92	3.6	4.81	26.2
4Pd/Co ₃ O ₄	3.1	3.7	3.83	22.2

N₂O PPM

Catalyst	Reaction Temperature			
	400 °C	450 °C	550 °C	650 °C
Co ₃ O ₄	0	0	0	0
1Pd/Co ₃ O ₄	0	0	0	0
2Pd/Co ₃ O ₄	0	0	0	0
3Pd/Co ₃ O ₄	0	0	0	0
4Pd/Co ₃ O ₄	0	0	0	0

N₂ PPM*

Catalyst	Reaction Temperature			
	400 °C	450 °C	550 °C	650 °C
Co ₃ O ₄	1	22.6	70.9	47.2
1Pd/Co ₃ O ₄	50	105	153	762
2Pd/Co ₃ O ₄	52	107	163	888
3Pd/Co ₃ O ₄	68.7	130	229	1228
4Pd/Co ₃ O ₄	62.85412	126	183	1029

***N₂ ppm calculated from nitrogen mass balance**

NO₂ PPM

Catalyst	Reaction Temperature
----------	----------------------

	400 °C	450 °C	550 °C	650 °C
Co ₃ O ₄	306	169	32.7	0
1Pd/Co ₃ O ₄	158	89	0	23.6
2Pd/Co ₃ O ₄	164	89	0	48
3Pd/Co ₃ O ₄	144	88	4	55
4Pd/Co ₃ O ₄	169.7	101	0	61

Table 2. NO conversion, N₂, N₂O, NO₂ ppm values of the Co₃O₄ and various PtO/Co₃O₄ catalysts in the temperature region 400 – 650 °C.

NO conversion

Catalyst	Reaction Temperature			
	400 °C	450 °C	550 °C	650 °C
Co ₃ O ₄	3.15	2.27	1.85	0.74
1Pt/Co ₃ O ₄	6.16	3.38	2.67	2.59
2Pt/Co ₃ O ₄	8.95	5.3	3.73	4
3Pt/Co ₃ O ₄	7.66	4.64	3.99	5.42
4Pt/Co ₃ O ₄	7.97	4.91	5.25	7.01

N₂O PPM

Catalyst	Reaction Temperature			
	400 °C	450 °C	550 °C	650 °C
Co ₃ O ₄	0	0	0	0
1Pt/Co ₃ O ₄	0	0	0	0
2Pt/Co ₃ O ₄	0	0	0	0
3Pt/Co ₃ O ₄	0	0	0	0
4Pt/Co ₃ O ₄	0	0	0	0

N₂ PPM*

catalyst	Reaction Temperature			
	400	450	550	650
Co ₃ O ₄	1	22.6	70.9	47.2
1Pt/Co ₃ O ₄	54.4	48.2	116	147
2Pt/Co ₃ O ₄	53.5	52.8	116	176
3Pt/Co ₃ O ₄	44.2	52	145	251
4Pt/Co ₃ O ₄	42	61	208	339

***N₂ ppm calculated from nitrogen mass balance**

NO₂ PPM

catalyst	Reaction Temperature			
	400	450	550	650
Co ₃ O ₄	306	169	32.7	0
1Pt/Co ₃ O ₄	556	294	85	23.6
2Pt/Co ₃ O ₄	771	411	128	43.6

3Pt/Co ₃ O ₄	674	357	107	36.9
4Pt/Co ₃ O ₄	713	373	112	41

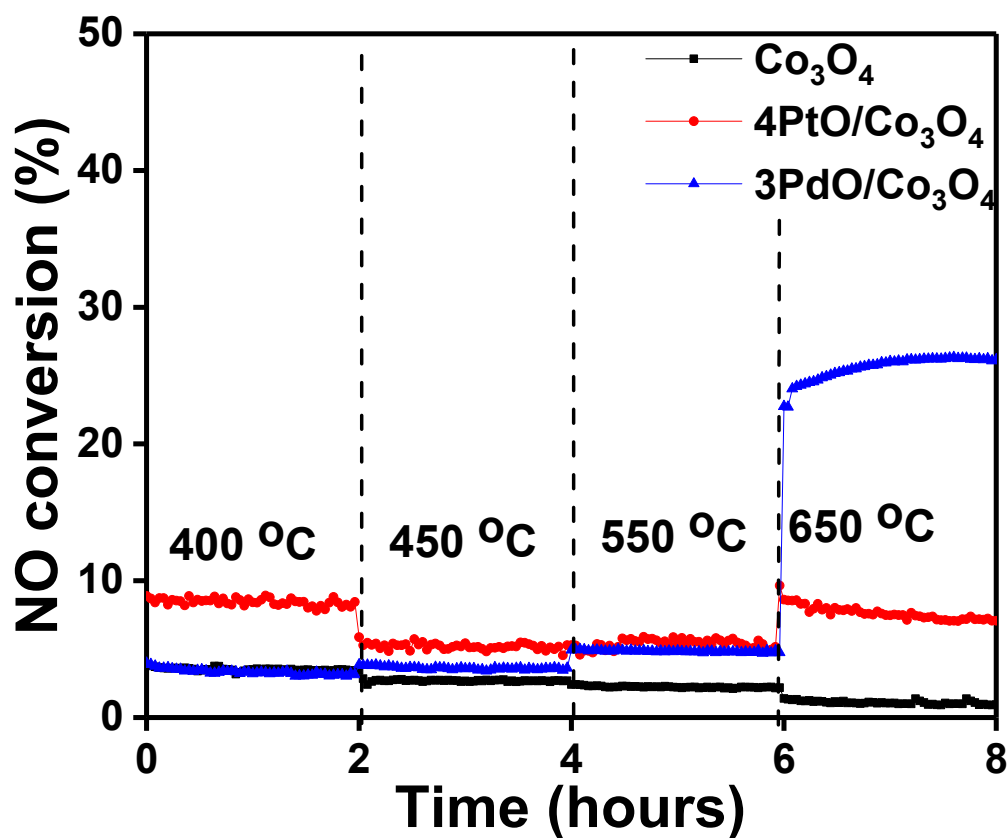
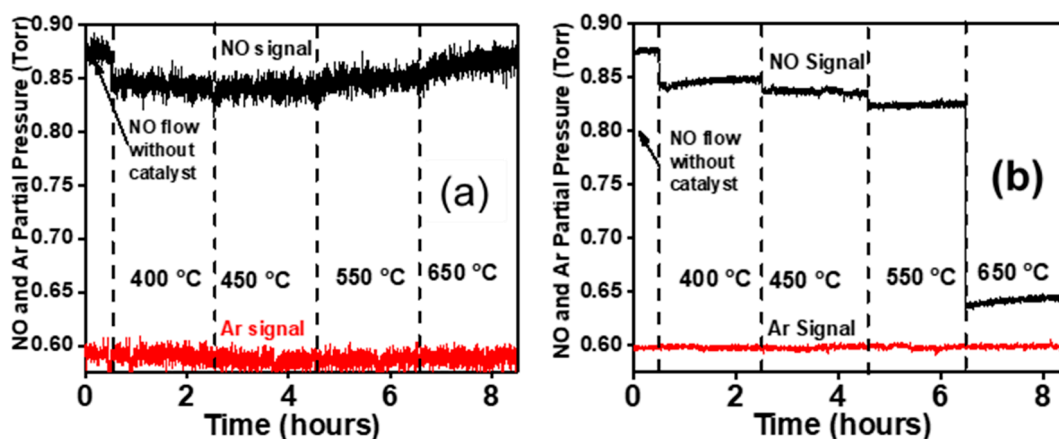


Figure S1. Steady state NO conversion values of the Co₃O₄, 3PdO/Co₃O₄ and 4PtO/Co₃O₄ catalysts during the direct NO decomposition in the temperature region 400 to 650 °C.



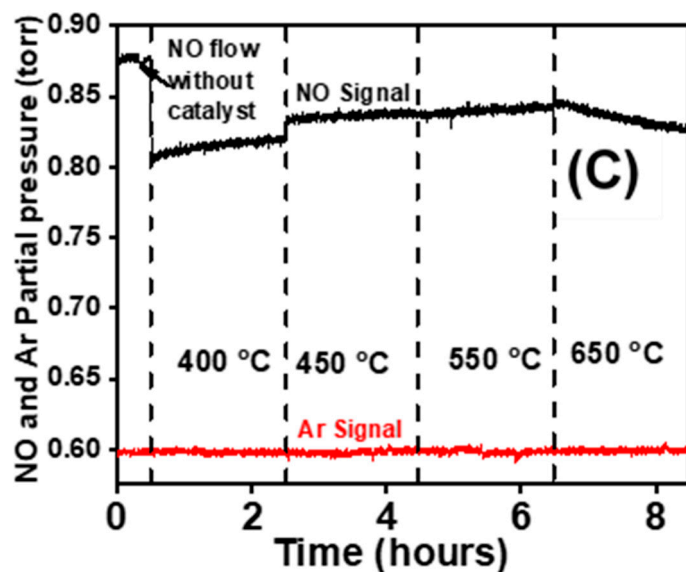


Figure S2. NO and Ar M.S. partial pressures of the (a) Co_3O_4 , (b) $3\text{PdO}/\text{Co}_3\text{O}_4$, and (c) $3\text{PtO}/\text{Co}_3\text{O}_4$ catalysts during the steady state direct NO decomposition in the temperature region 400 to 650 °C.

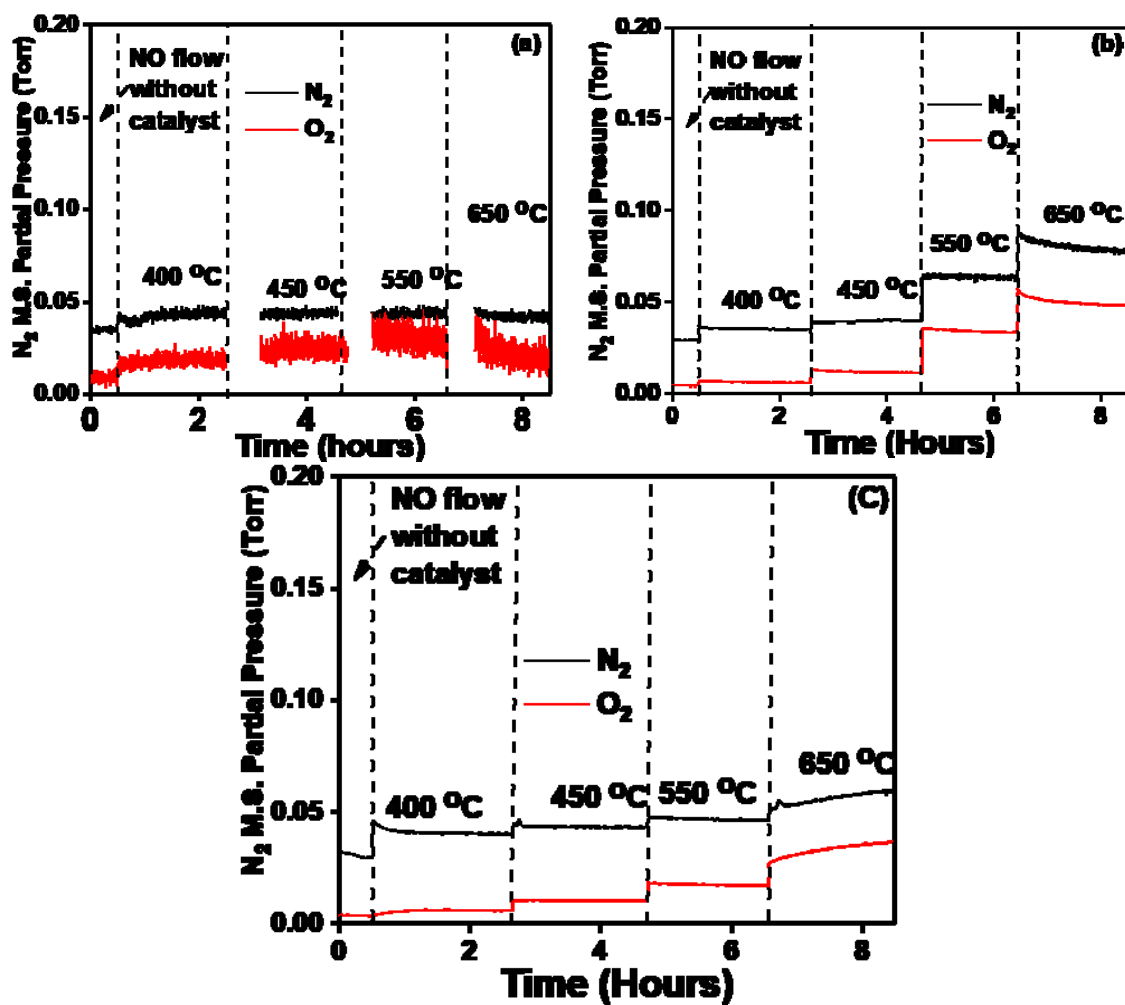


Figure S3. N_2 and O_2 M.S. partial pressures of the (a) Co_3O_4 , (b) $3\text{PdO}/\text{Co}_3\text{O}_4$, and (c) $3\text{PtO}/\text{Co}_3\text{O}_4$ catalysts during the steady state direct NO decomposition in the temperature region 400 to 650 °C.

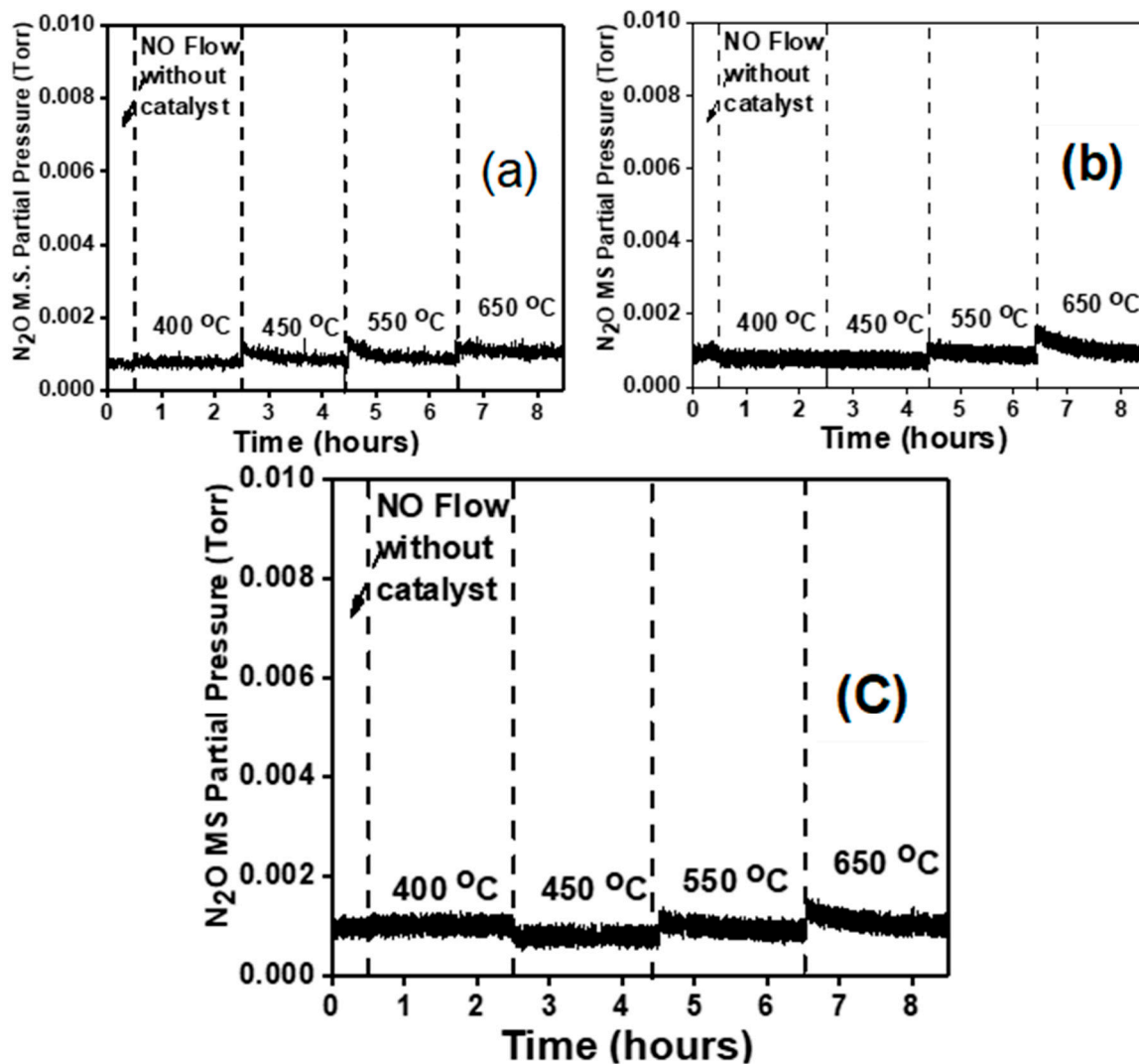
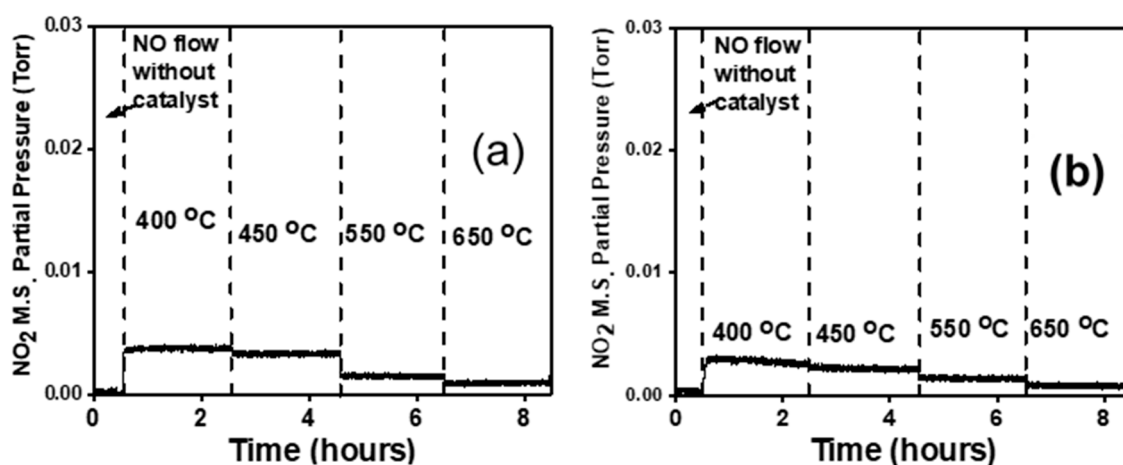


Figure S4. N_2O M.S. partial pressures of the (a) Co_3O_4 , (b) $3PdO/Co_3O_4$, and (c) $3PtO/Co_3O_4$ catalysts during the steady state direct NO decomposition in the temperature region 400 to 650 °C.



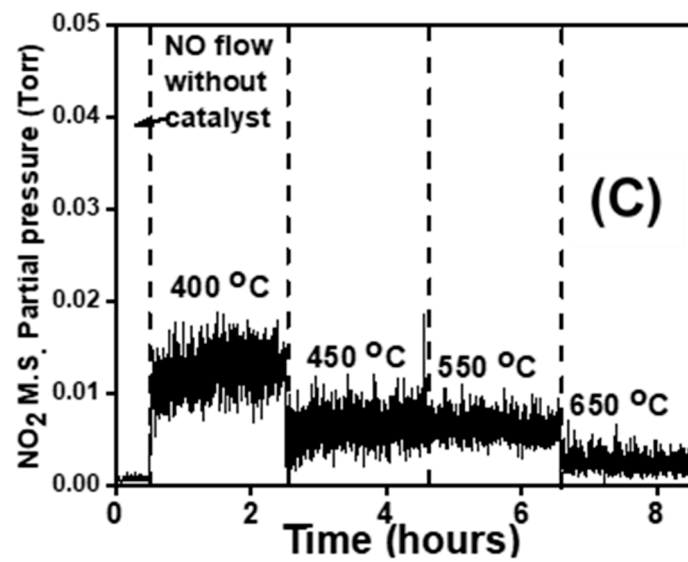


Figure S5. NO₂ M.S. partial pressures of the (a) Co₃O₄, (b) 3PdO/Co₃O₄, and (c) 3PtO/Co₃O₄ catalysts during the steady state direct NO decomposition in the temperature region 400 to 650 °C.