Pollutants emissions during mild catalytic DPF regeneration in light-duty vehicles

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$La_{1-x}A_xNi_{1-y}B_yO_3$ nanostructured perovskite-type oxides catalysts (where A = Na, K, Rb and B = Cu; x = 0, 0.2 and y = 0, 0.05, 0.1), also supporting 2% in weight of gold, were prepared via the so-called "*Solution Combustion Synthesis (SCS)*" method, and characterized by means of XRD, BET, FESEM-EDS and TEM analyses. The performance of these catalysts towards the simultaneous oxidation of soot and CO was evaluated. The 2 wt.% Au-$La_{0.8}K_{0.2}Ni_{0.9}Cu_{0.1}O_3$ showed the best performance with a peak carbon combustion temperature of 367°C and the half conversion of CO reached at 141°C. The same nanostructured catalyst, deposited by *in situ* SCS directly over a SiC filter and tested on real diesel exhaust gases, fully confirmed the encouraging results obtained on the powder catalyst. The tests carried out on an engine bench and equipped with a Scanning Mobility Particle Sizer (SMPS), showed a similar behaviour of the catalytic and bare wall-flow filter concerning the emission of secondary nanoparticles ($PM_{0.1}$) during regeneration.

Table 1. Catalyst characterization tests: BET and catalytic activity towards both C and CO oxidation.

Catalyst	BET, m^2/g	Carbon oxidation	CO oxidation	
		T_p, °C	T_{50}, °C	T_{100}, °C
Non catalytic combustion	-	650	530	-
$LaNiO_3$	15.4	430	242	280
2wt.%Au-$LaNiO_3$	10.4	431	156	197
$La_{0.8}Na_{0.2}NiO_3$	5.9	399	241	278
2wt.%Au-$La_{0.8}Na_{0.2}NiO_3$	5.7	400	155	198
$La_{0.8}Na_{0.2}Ni_{0.95}Cu_{0.05}O_3$	4.9	395	239	277
2wt.%Au-$La_{0.8}Na_{0.2}Ni_{0.95}Cu_{0.05}O_3$	4.8	394	154	197
$La_{0.8}Na_{0.2}Ni_{0.9}Cu_{0.1}O_3$	5.2	394	235	276
2wt.%Au-$La_{0.8}Na_{0.2}Ni_{0.9}Cu_{0.1}O_3$	5.1	395	154	196
$La_{0.8}K_{0.2}NiO_3$	4.5	358	230	275
2wt.%Au-$La_{0.8}K_{0.2}NiO_3$	4.4	359	151	194
$La_{0.8}K_{0.2}Ni_{0.95}Cu_{0.05}O_3$	4.8	373	228	274
2wt.%Au-$La_{0.8}K_{0.2}Ni_{0.95}Cu_{0.05}O_3$	4.6	372	145	190
$La_{0.8}K_{0.2}Ni_{0.9}Cu_{0.1}O_3$	4.7	368	225	275
2wt.%Au-$La_{0.8}K_{0.2}Ni_{0.9}Cu_{0.1}O_3$	4.5	367	141	183
$La_{0.8}Rb_{0.2}NiO_3$	3.8	369	238	277
2wt.%Au-$La_{0.8}Rb_{0.2}NiO_3$	3.8	368	154	193
$La_{0.8}Rb_{0.2}Ni_{0.95}Cu_{0.05}O_3$	4.0	378	237	275
2wt.%Au-$La_{0.8}Rb_{0.2}Ni_{0.95}Cu_{0.05}O_3$	3.9	378	153	193
$La_{0.8}Rb_{0.2}Ni_{0.9}Cu_{0.1}O_3$	4.1	394	235	278
2wt.%Au-$La_{0.8}Rb_{0.2}Ni_{0.9}Cu_{0.1}O_3$	4.0	393	151	190

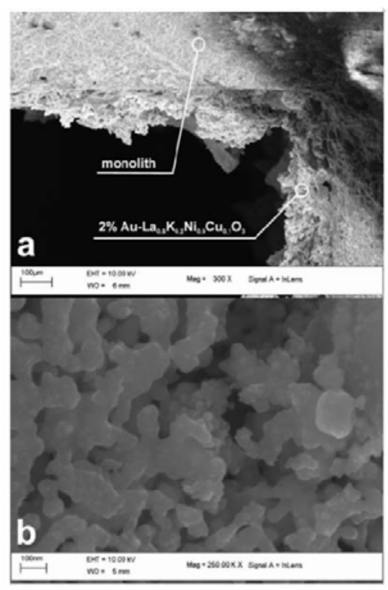

Fig. 1. FESEM view of the microstructure of a 2 wt.% Au- $La_{0.8}K_{0.2}Ni_{0.9}Cu_{0.1}O_3$ catalyst layer deposited over a SiC wall-flow trap: a) 300X; b) 250000X.

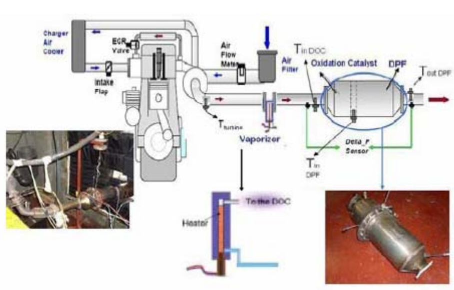

Fig. 2. Schematic view of the engine-bench pilot plant.

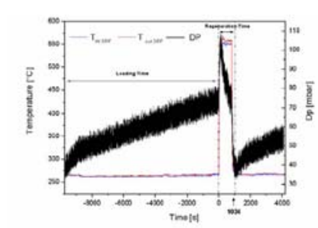

Fig. 3. Loading and regeneration runs for the 2 wt. % Au-$La_{0.8}K_{0.2}Ni_{0.9}Cu_{0.1}O_3$-catalyzed DPF.

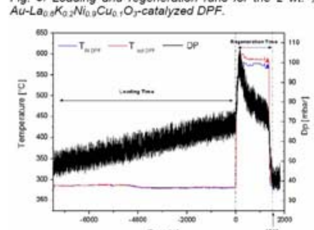

Fig. 4. Loading and regeneration runs for the non catalyzed wall-flow traps.