Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

Highly active MnO_x-CeO_2 catalyst for diesel soot combustion

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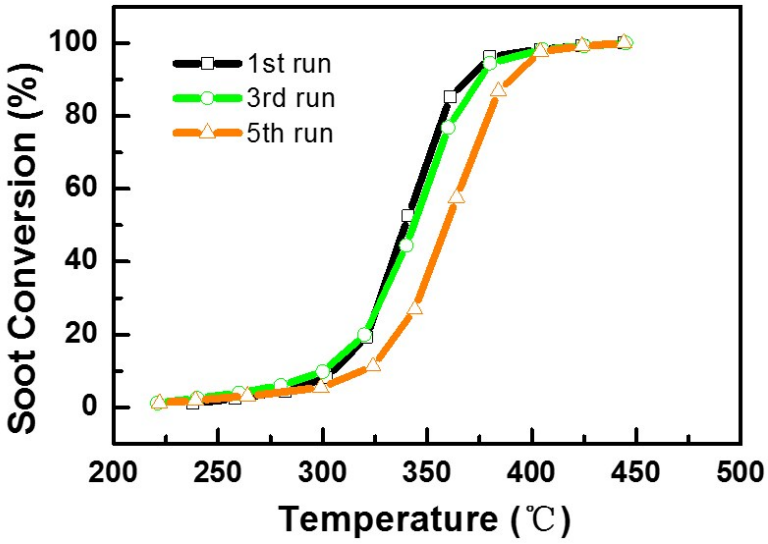


Fig. S1 The cycle catalytic oxidation of soot over CM_{33} using a different mixing method: "wet mixing".

[Note that contrary to the mixing method used in the main text (designated as "dry mixing"), the "wet mixing" method was introduced to ensure the repeatability of contact condition between soot and the "spent catalyst" during the cycle experiments, which was conducted as follows: soot (10 mg) and catalyst (100 mg) were thoroughly dispersed in ethanol by ultrasonic for 20 min, then dried at 150°C and eventually mixed with silica pellets (1g) for 10 min with a spatula.]

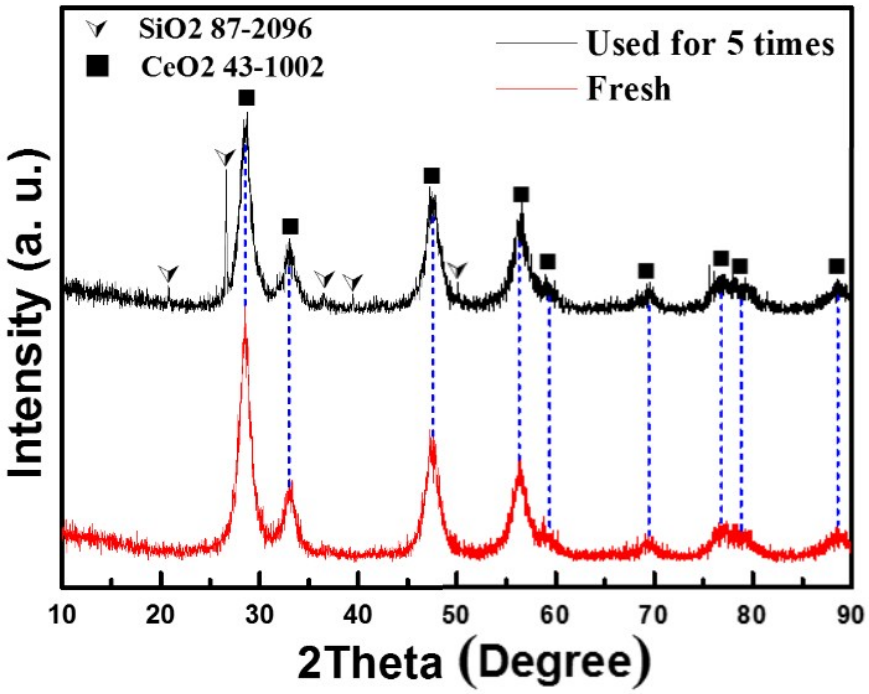


Fig. S2 The XRD patterns of the CM_{33} before and after cycle test.

[Note that the diffraction peaks corresponding to SiO2 were derived from the residual silica which was added to the catalyst-soot mixture during the activity test.]

Table S1 Temperatures of soot combustion over catalysts or without catalysts (loose contact mode). NG: not given.

Catalysts	T_m (°C)	T_f (°C)	Space velocity [mL/(g_{catal}·h)]	Reactant gases	Mass ratio of soot/catalyst	Ref.
$Au_{0.06}/LaFeO_3$	366	NG	30,000	5% O_2/ 0.2% NO/ Ar	1:10	23
$Ag/CeO_x/FeO_y$/ cordierite	334	400	NG	20% O_2/ 80% N_2	1:9	25
$Ba/MnO_x–CeO_2$	393	NG	300,000	10% O_2/ 0.1% NO/ N_2	1:10	10
$MnO_x–CeO_2$	400	NG	300,000	10% O_2/ 0.1% NO/ N_2	1:10	31
$MnO_x–CeO_2$	413	>510	NG	10% O_2/ 0.1% NO/ He	1:9	32
$Pt/MnO_x–CeO_2$	420	NG	330,000	10% O_2/ 0.08% NO/ Ar	1:10	33
$MnO_x–CeO_2$	418	NG	300,000	10% O_2/ 0.1% NO/ N_2	1:10	34
CuO_x-CeO_2/ ZrO_2-TiO_2	350	404	90,000	10% O_2/ 0.05% NO/ N_2	1:10	20
CM_{20}	326	360	120,000	10% O_2/ 0.05% NO/ N_2	1:10	This work
CM_{20}	350	392	330,000	10% O_2/ 0.05% NO/ N_2	1:10	This work
NULL	560	606	120,000	10% O_2/ 0.05% NO/ N_2	1:10	This work

[Note that due to a lack of standard measurement procedure, it is really hard to find data measured under totally identical conditions, nevertheless, we have tried our best to keep constant such key factors as contact mode (loose instead of tight), gas species [O_2 (and NO), balanced with inert gas, without H_2S or H_2O] and the mass ratio of soot/catalyst (1:10 or 1:9).]

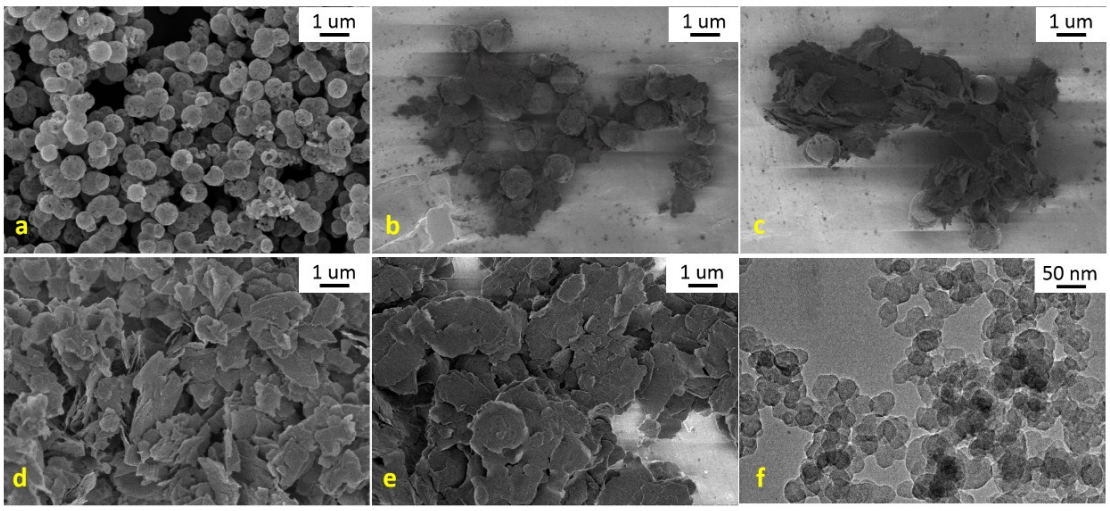


Fig. S3 SEM images of MnO_x (a), CM_{66} (b), CM_{50} (c), CM_5 (d), and CeO_2 (e); TEM image of soot (f).

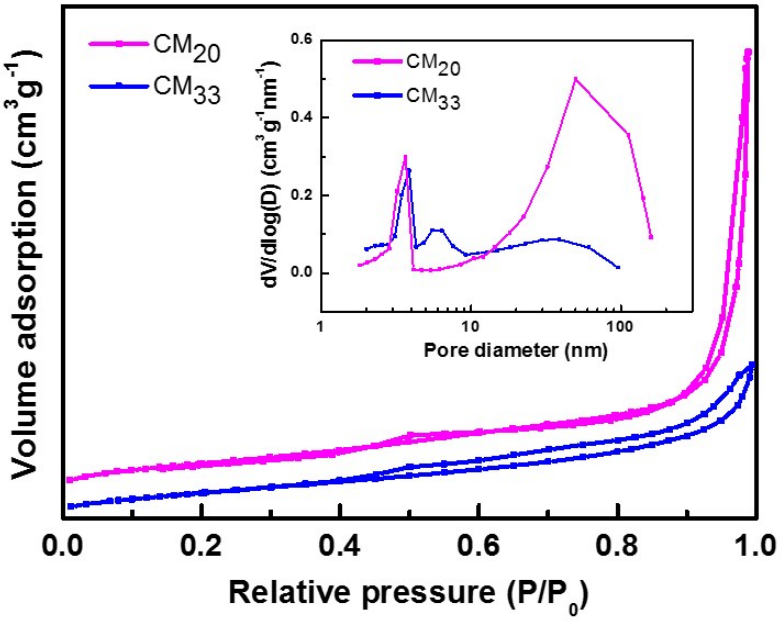


Fig. S4 N_2 adsorption/desorption isotherms and the inset corresponding pore size distributions of CM_{20} and CM_{33}.

Table S2 Specific surface areas, pore volumes and the pore sizes of all MnO_x-CeO_2 composites and the reference MnO_x and CeO_2.

Catalyst	S_{BET}[a] ($m^2\ g^{-1}$)	V_{BJH}[b] ($cm^3\ g^{-1}$)	D_p[c] (nm)
MnO_x	20.7	0.22	33
CM_{66}	72.2	0.21	8-27
CM_{50}	52.8	0.11	3-9
CM_{33}	75.3	0.15	6, 13-67
CM_{20}	73.6	0.38	25-144
CM_5	34.0	0.12	24-156
CeO_2	31.1	0.08	4-43

[a] determined by BET method;

[b] BJH Desorption Cumulative Pore Volume of pores between 17.000000 and 3000.000000 Å Diameter;

[c] BJH Desorption Average Pore Diameter (4V/A).

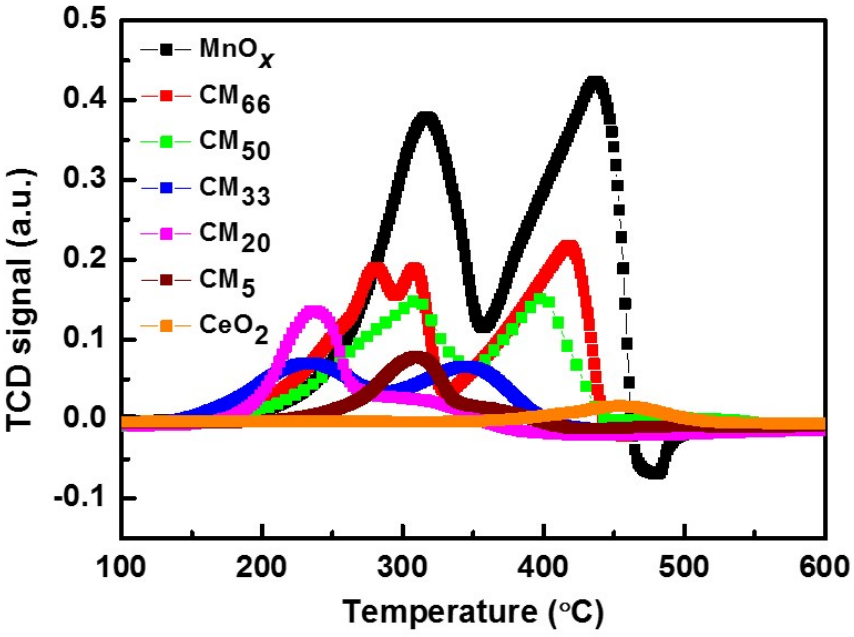


Fig. S5 H_2-TPR curves of all MnO_x-CeO_2 composites and the reference MnO_x and CeO_2.

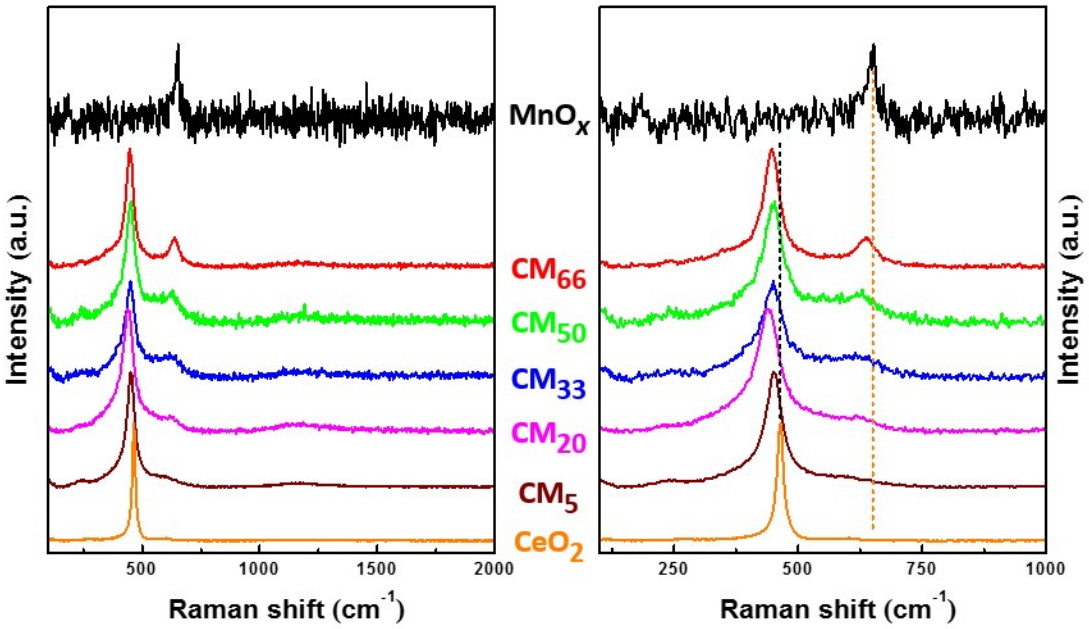
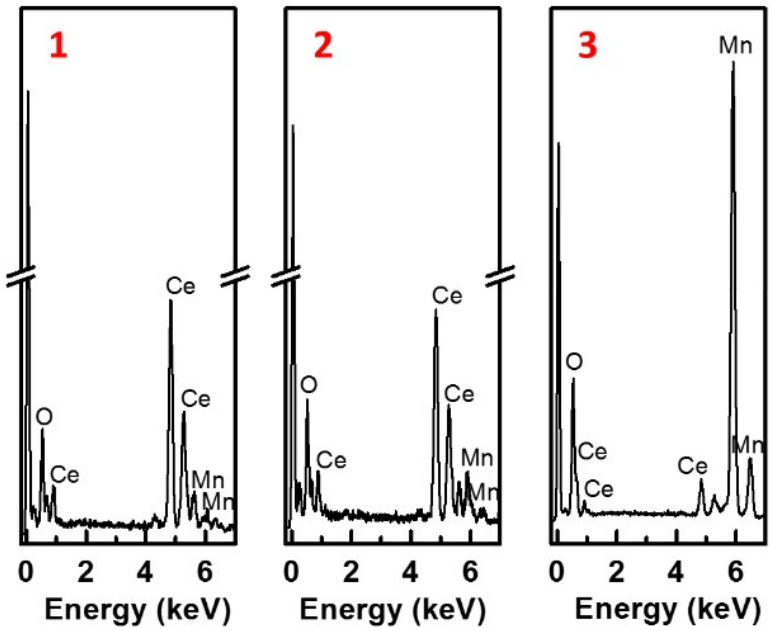


Fig. S6 Raman spectra over all MnO_x-CeO_2 composites and the reference MnO_x and CeO_2. Left: Raman spectra in a wide range; Right: The corresponding Raman spectra in a narrow range.



Atomic ratios (%)	O	Mn	Ce	Mn/(Mn+Ce)
1	52.4	1.4	46.2	2.9
2	54.4	7.1	38.5	15.6
3	43.1	52.7	4.2	92.6

Fig. S7 SEM-EDS results of different areas in CM_{33}.

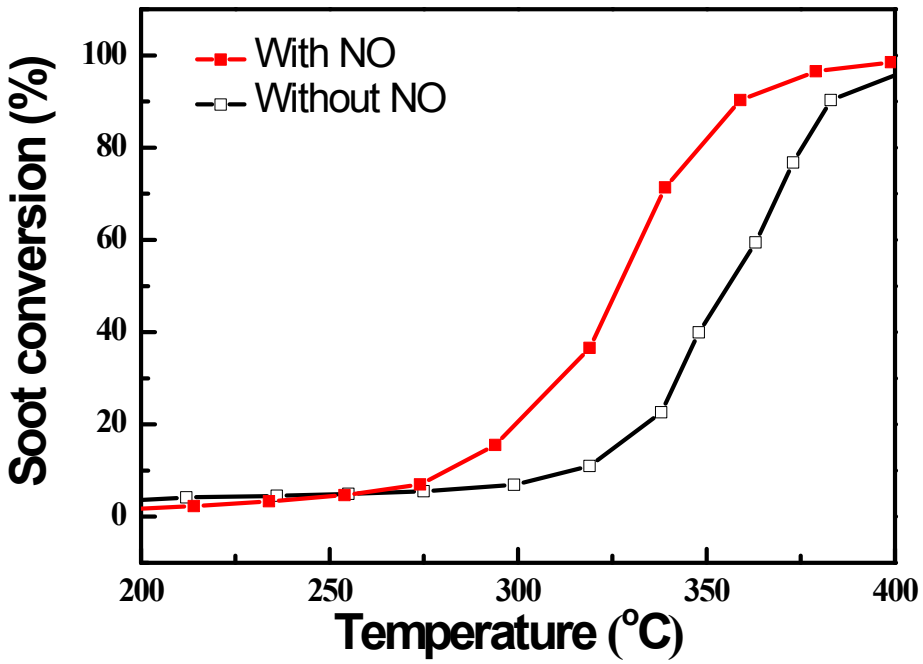


Fig. S8 Temperature-programed soot oxidation experiments over CM_{20} with or without NO existing in the feed gas.