Supporting Information

Plasma-induced construction of defect-enriched perovskite oxides for catalytic methane combustion

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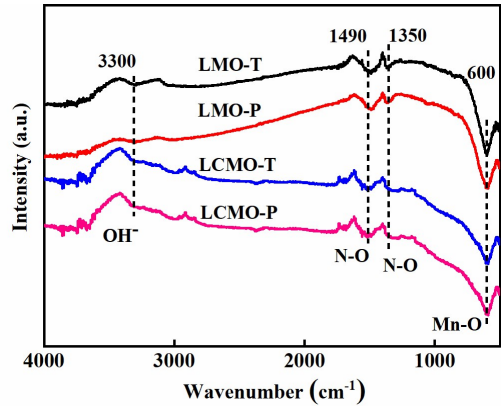

Fig.S1 FTIR spectra of all catalysts.

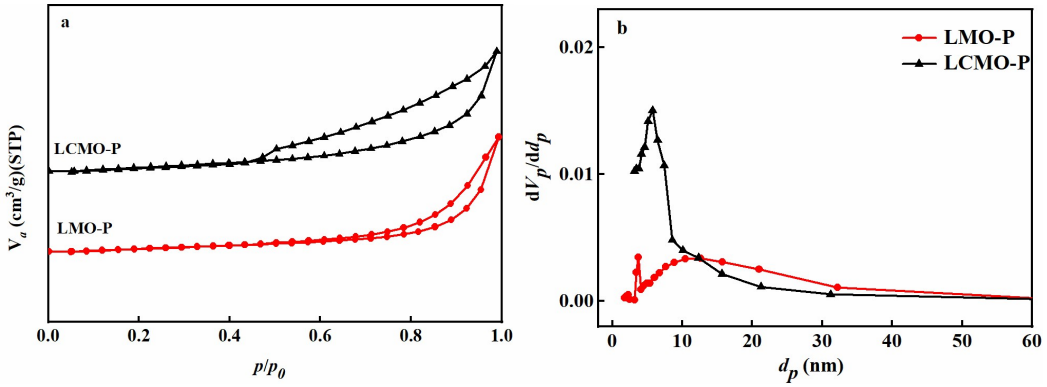

Fig.S2 (a) N_2 adsorption-desorption isotherms and (b) pore-size distributions of LMO-P and LCMO-P catalysts.

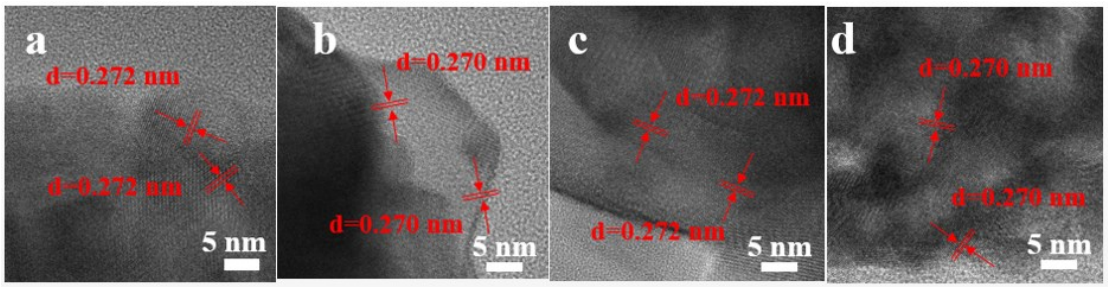

Fig.S3 HRTEM images of (a) LMO-T, (b) LCMO-T, (c) LMO-P and (d) LCMO-P catalysts.

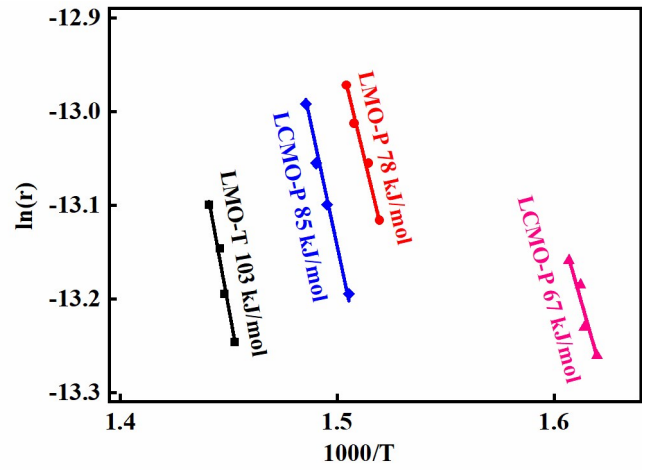

Fig.S4 Arrhenius plots for CH_4 combustion over all catalysts.

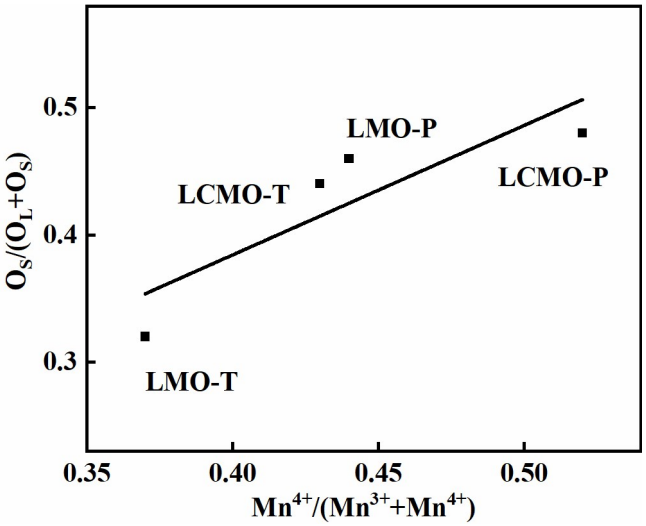

Fig.S5 Relationship among the $Mn^{4+}/(Mn^{3+}+Mn^{4+})$ and $O_S/(O_S+O_L)$ of all catalysts.

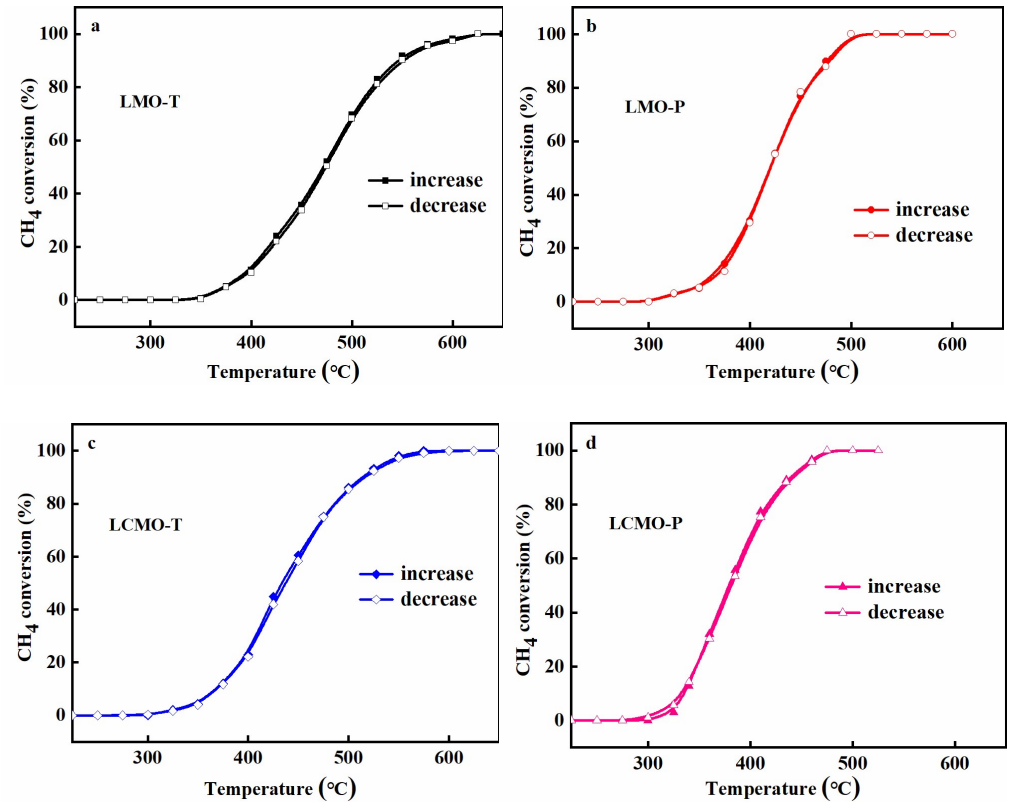

Fig.S6 Cycle performance tests of all catalysts.

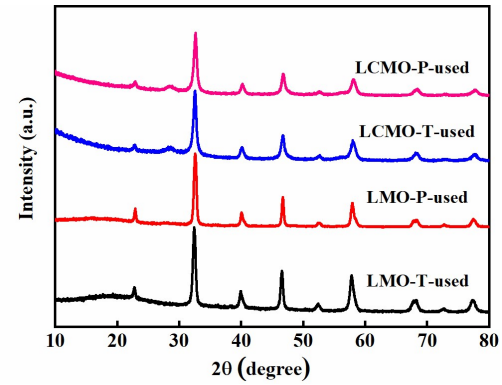

Fig.S7 XRD patterns of all used catalysts.

Tab.S1 Detailed data of pore volume (V_p), average pore size (D_p), ICP results and surface atomic concentration of all catalysts

Catalysts	V_P[a] ($cm^3 \cdot g^{-1}$)	D_p[a](nm)	Ce content[b] (wt.%)	Surface atomic concentration (%)		
				Mn	La	Ce
LMO-T	-	-	-	16.1	22.0	-
LMO-P	0.12	27.9	-	17.0	23.2	-
LCMO-T	-	-	11.7	17.6	16.2	3.2
LCMO-P	0.23	11.0	11.2	19.5	16.6	2.1

[a] The data were calculated by BJH method according to the desorption branch.

[b] The data were calculated by ICP analysis.

Tab.S2 Comparison of CH_4 catalytic oxidation over other catalysts reported in the literature.

Catalysts	Reaction conditions	T_{50} (ºC)	T_{90} (ºC)	Reaction rate ($\mu mol \cdot g^{-1} \cdot s^{-1}$)[a]	Ref.
LCMO-P	2.5 vol.% CH_4, 30000 h^{-1}	380	440	1.47	This work
$LaMn_{0.8}Mg_{0.2}O_3$	1 vol.% CH_4, 30000 h^{-1}	450	525	0.47	[1]
$LaMnO_3$	3 vol.% CH_4, 30000 h^{-1}	480	570	1.31	[2]
$La_{1-x}FeO_{3-\delta}$	0.5 vol.% CH_4, 240000 h^{-1}	500	625	0.75	[3]
$NiO/LaNiO_3$	10 vol.% CH_4, 36000 h^{-1}	480	575	0.79	[4]
$La(Mn, Fe)O_{3+\lambda}$	1 vol.% CH_4, 15000 h^{-1}	439	493	0.32	[5]

[a] Reaction rate calculated from the active test at 350 °C.

References:

[1] Zhu L, Lu G, Wang Y, et al. Effects of preparation methods on the catalytic performance of $LaMn_{0.8}Mg_{0.2}O_3$ perovskite for methane combustion. Chinese Journal of Catalysis, 2010, 31(8):1006-1012.

[2] Guo G, Lian K, Wang L, et al. High specific surface area $LaMO_3$ (M = Co, Mn) hollow spheres: synthesis, characterization and catalytic properties in methane combustion. RSC Advances, 2014, 4(102):58699-58707.

[3] Faye J, Baylet A, Trentesaux M, et al. Influence of lanthanum stoichiometry in $La_{1-x}FeO_{3-\delta}$ perovskites on their structure and catalytic performance in CH_4 total oxidation. Applied Catalysis B-Environmental, 2012, 126:134-143.

[4] Nie L, Wang J, Tan Q. In-situ preparation of macro/mesoporous $NiO/LaNiO_3$ pervoskite composite with enhanced methane combustion performance. Catalysis Communications, 2017, 97:1-4.

[5] Miao F, Wang F, Mao D, et al. Effect of different reaction conditions on catalytic activity of $La(Mn, Fe)O_{3+\lambda}$ catalyst for methane combustion. Materials Research Express, 2019, 6(5) :15.