Electronic Supplementary Information (ESI)

Catalytic combustion of diesel soot over Fe and Ag-doped manganese oxides: Role of the heteroatoms in the catalytic performances

Yasutaka Kuwahara,a,b Akihiro Fujibayashi,a Hiroki Uehara,a Kohsuke Mori,a,b,c and Hiromi Yamashita,a,b,*

a Division of Materials and Manufacturing Science, Graduate School of Engineering, Osaka University, 2-1 Yamada-oka, Suita, Osaka 565-0871, Japan

b Unit of Elements Strategy Initiative for Catalysts & Batteries (ESICB), Kyoto University, Katsura, Kyoto 615-8520, Japan

c Japan Science and Technology Agency (JST), Precursory Research for Embryonic Science and Technology (PRESTO), 4-1-8 Honcho, Kawaguchi, Saitama 332-0012, Japan.

* Tel: (+81) 6-6879-7457, Fax: (+81) 6-6879-7457
E-mail: yamashita@mat.eng.osaka-u.ac.jp
Fig. S1 (a) SEM image and the corresponding EDX mapping images for O, Mn and Fe of Fe25%-Mn2O3 catalyst.
Fig. S2 SEM images of (a) pure Mn$_2$O$_3$, (b) Fe12%-Fe$_2$O$_3$, (c) Fe25%-Fe$_2$O$_3$ and (d) Fe50%-Fe$_2$O$_3$ catalysts.
Fig. S3 (a) Mn K-edge XAFS spectra and (b) RDFs of Mn K-edge EXAFS spectra of pure Mn$_2$O$_3$, the series of Fe-doped Mn$_2$O$_3$ catalysts and several reference oxides (MnO, Mn$_2$O$_3$ and MnO$_2$).
Fig. S4 (a) Fe K-edge XAFS spectra and (b) RDFs of Fe K-edge EXAFS spectra of the series of Fe-doped Mn$_2$O$_3$ catalysts and several reference oxides (FeO, Fe$_3$O$_4$ and Fe$_2$O$_3$).
Fig. S5 Comparison of soot combustion activities of (A) Ag1.5%-doped Fe-Mn₂O₃ catalyst synthesized by varying the content of Fe (Fe = 0, 12, 25 and 50 mol%) and (B) Ag-doped Fe25%-Mn₂O₃ catalysts synthesized by varying the content of Ag (Ag = 0, 0.75, 1.5 and 3.0 mol%). The soot oxidation performance was evaluated by TG analysis in a flow of air under tight contact mode using mixtures of catalysts and model soot (Printex®V) with the weight ratio of 10:1. $T_{10}$ and $T_{50}$ values are defined as the temperatures at which 10 wt% and 50 wt% of soot is removed.
Fig. S6 XRD patterns of Ag/Fe-doped Mn\textsubscript{2}O\textsubscript{3} catalysts synthesized by varying the content of Ag (Ag = 0, 0.75, 1.5 and 3.0 mol%). The line shown in the bottom represents the standard XRD pattern of \(\alpha\)-Mn\textsubscript{2}O\textsubscript{3} (PDF\#00-041-1442).
Fig. S7 (a) Mn 2p XPS spectra and (b) O 1s XPS spectra of pure Mn$_2$O$_3$, Fe25%-Mn$_2$O$_3$, Ag1.5%-Mn$_2$O$_3$ and Ag1.5%-Fe25%-Mn$_2$O$_3$ catalysts.
**Fig. S8** (left) Ag 3d XPS spectra and (right) Ag MNN auger spectra of Ag1.5%-Fe25%-Mn$_2$O$_3$ catalyst: (a) after oxidation at 400 °C in 20% O$_2$/He and (b) after successive reduction at 400 °C in 20% H$_2$/He. The peak located at around 356 eV in the right is assignable to Ag(I) species, while that located at around 358 is associated with Ag(0) species (S. G. Aspromonte, M. D. Mizrahi, F. A. Schneeburger, J. M. R. López and A. V. Boix, *J. Phys. Chem. C*, 2013, **117**, 25433-25442).

![Ag 3d XPS spectra](image1.png)

![Ag MNN auger spectra](image2.png)
Fig. S9 XRD patterns of Ag1.5%-Fe25%-Mn$_2$O$_3$ catalyst before and after the soot oxidation reaction.