## Supporting Information for: Synergy between Fe and Promoter Ions Supported on Nanoceria Influences $NO_x$ Reduction Catalysis

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Figure S1: Activity  $(\mu mol/g/s)$  of  $Fe(NO_3)_3/CeO_2$ ,  $Fe(NO_3)_3/Na-CeO_2$ , and  $NaFeEDTA/CeO_2$  at 250°C.

Table S1: Crystalline (nanoparticle) size (nm) and lattice constant (Å) from XRD pattern refinements. ICP wt%'s of Fe and BET measurements for  $Fe(NO_3)_3$ -CeO<sub>2</sub>,  $Fe(NO_3)_3/Na-CeO_2$  and NaFeEDTA/CeO<sub>2</sub> are presented.

| Sample                 | size (nm)      | a (Å, XRD)        | ICP wt% (Fe) | BET $(m^2/g)$ |
|------------------------|----------------|-------------------|--------------|---------------|
| $Fe(NO_3)_3$ - $CeO_2$ | $22.0 \pm 0.2$ | $5.411 \pm 0.001$ | 1.00         | 101           |
| $Fe(NO_3)_3/Na-CeO_2$  | $20.6 \pm 0.1$ | $5.416 \pm 0.001$ | 1.32         | 101           |
| $NaFeEDTA/CeO_2$       | $23.2 \pm 0.1$ | $5.413 \pm 0.001$ | 1.35         | 101           |



Figure S2: (a) Room temperature XRD pattern and Rietveld refinement (solid line) of the support nanoceria and the residual of nanoceria is shown. Lattice constant and estimates of crystallite sizes are of the order of 5.411 Å and 20 nm, respectively. Short vertical bars indicate the positions of the expected Bragg reflections from the refinement. (b) TEM image of nanoceria support.

Table S2: Mössbauer spectral fit parameters of catalysts in vacuum at 350 °C. Linewidth  $(\Gamma)$  is 0.13 mm/s is set by the life time of excited state. Isomer shift  $(\delta)$ , quadrupole shift  $(\Delta)$  of distorted  $(\delta_1, \Delta_1)$  and undistorted  $(\delta_2, \Delta_2)$  sites are presented.

| Sample                | $\delta_1(\text{mm/s})$ | $\Delta_1 \ (mm/s)$ | $\delta_2(\text{mm/s})$ | $\Delta_2 \ (\mathrm{mm/s})$ |
|-----------------------|-------------------------|---------------------|-------------------------|------------------------------|
| $Fe(NO_3)_3/CeO_2$    | $0.15 \pm 0.01$         | $0.61 \pm 0.01$     | $0.23 \pm 0.01$         | $0.14 \pm 0.02$              |
| $Fe(NO_3)_3/Na-CeO_2$ | $0.15 \pm 0.01$         | $0.61 \pm 0.01$     | $0.24 \pm 0.01$         | $0.15 \pm 0.02$              |
| $NaFeEDTA/CeO_2$      | $0.15 \pm 0.01$         | $0.61 \pm 0.01$     | $0.24 \pm 0.01$         | $0.15 \pm 0.02$              |



Figure S3: HAADF images acquired in the STEM mode of Ce atoms in  $Fe(NO_3)_3/CeO_2$  nanoparticles are shown.



Figure S4: HAADF images acquired in the STEM mode of Fe atoms in  $\rm Fe(NO_3)_3/CeO_2$  nanoparticles are shown.



Figure S5: HAADF images acquired in the STEM mode of O atoms in  $\rm Fe(NO_3)_3/CeO_2$  nanoparticles are shown.



Figure S6: Raman spectra of nanoceria support and  $Fe(NO_3)_3/CeO_2$  nanocrystallites are shown as a representative case. The inset shows that spectra are similar. The Raman-active mode at  $\omega = 466 \text{ cm}^{-1}$  is due to Ce – O8 vibration unit and sensitive to any disorder in lattice oxygen. This spectra results are consistent with the Ce  $M_{5,4}$  edge XAS results that the three systems have identical Ce<sup>3+</sup> and oxygen vacancies.



Figure S7: Na K-edge XAS of  $Fe(NO_3)_3/CeO_2$  and NaFeEDTA/CeO<sub>2</sub> shows no change in valence and local environment of Na ions.



Figure S8: Mössbauer spectra of the dispersed Fe on nanoceria supports measured under ambient conditions.



Figure S9: Mössbauer spectra of the dispersed Fe on nanoceria supports measured at 350 °C in vacuum (spectra are offset for clarity). Two different  $Fe^{3+}$  species are identified with distorted and undistorted  $Fe^{3+}$  environments. The solid lines are fits as described in the text.



Figure S10: Temperature dependent Mössbauer spectra of NaFeEDTA/CeO $_2$  in vacuum.



Figure S11: Mössbauer spectroscopy of NaFeEDTA/CeO<sub>2</sub> measured in vacuum and NO under identical acquisition times. The f-factor dramatically decreases in NO environment compared to vacuum as discussed in the main text.