Supporting Information

Selective CO_2 Electroreduction over Oxide-Derived Gallium Catalyst

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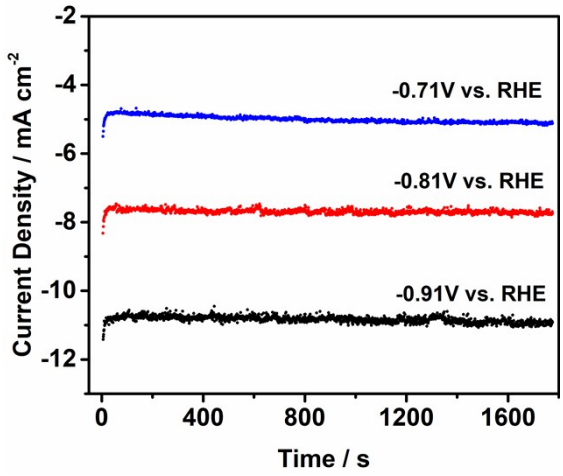

Fig. S1. Cathodic current density at other potentials after first tested at -0.61 V vs. RHE on Gallia gel/C electrode.

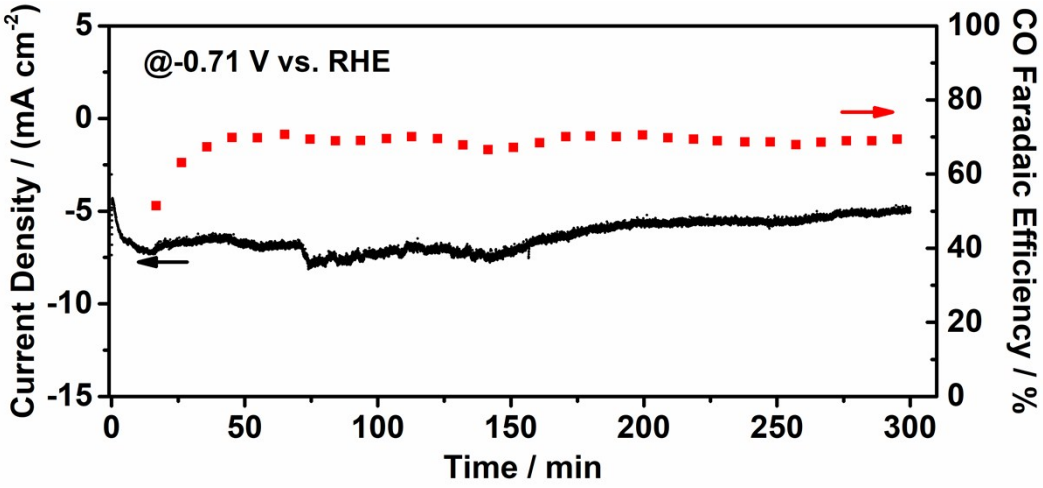

Fig. S2 Stability test of Gallia gel/C at -0.71 V vs. RHE in CO_2-saturated 0.1 M $KHCO_3$ solution.

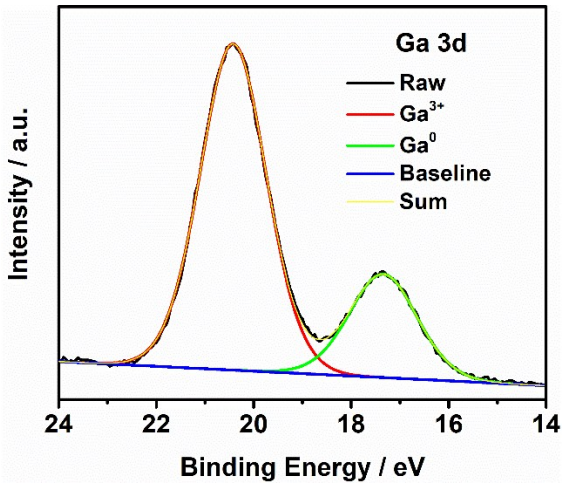

Fig. S3. (a) High-resolution Ga 3d XPS spectra of Gallia gel/C electrode after the CO_2RR measurements with activation at -0.61 V vs. RHE.

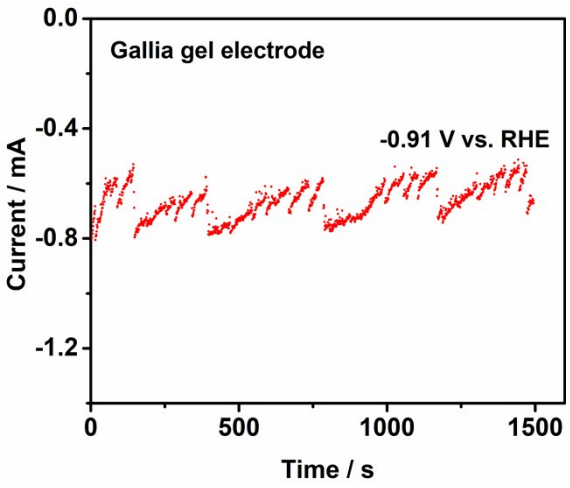

Fig. S4. Cathodic current plot for gallia gel electrode tested at -0.91 V vs. RHE with the same Ga loading with Gallia gel/C electrode.

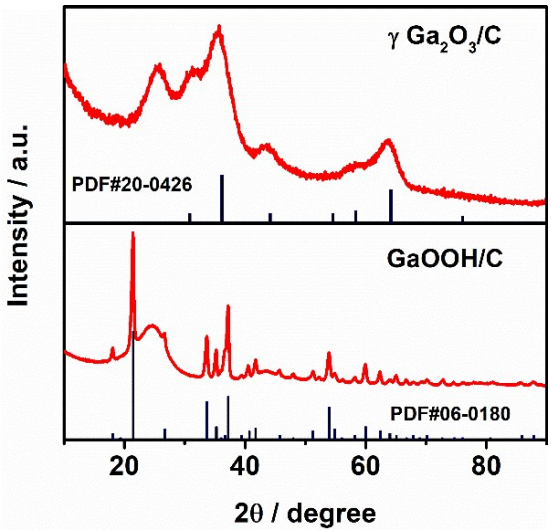

Fig. S5. XRD patterns for γ Ga_2O_3/C and GaOOH/C and corresponding standard PDF documents.

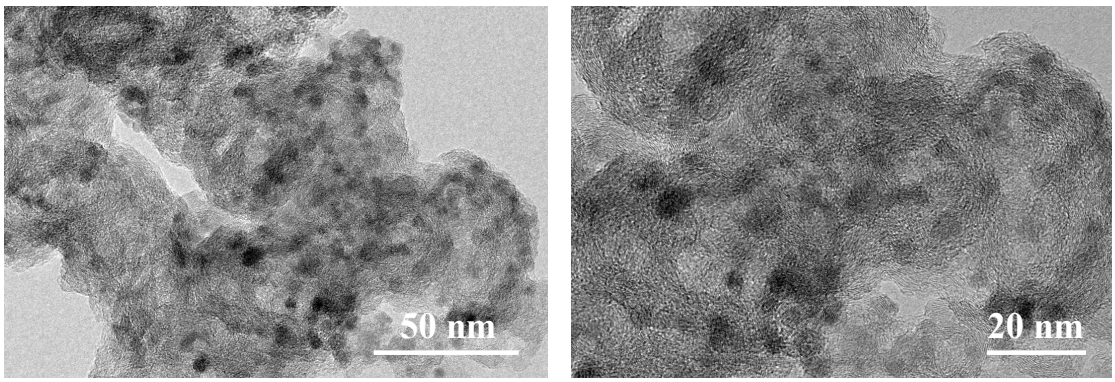

Fig. S6. TEM images for γ Ga_2O_3/C at different resolutions, showing well-dispersion of γ Ga_2O_3 nanoparticles.

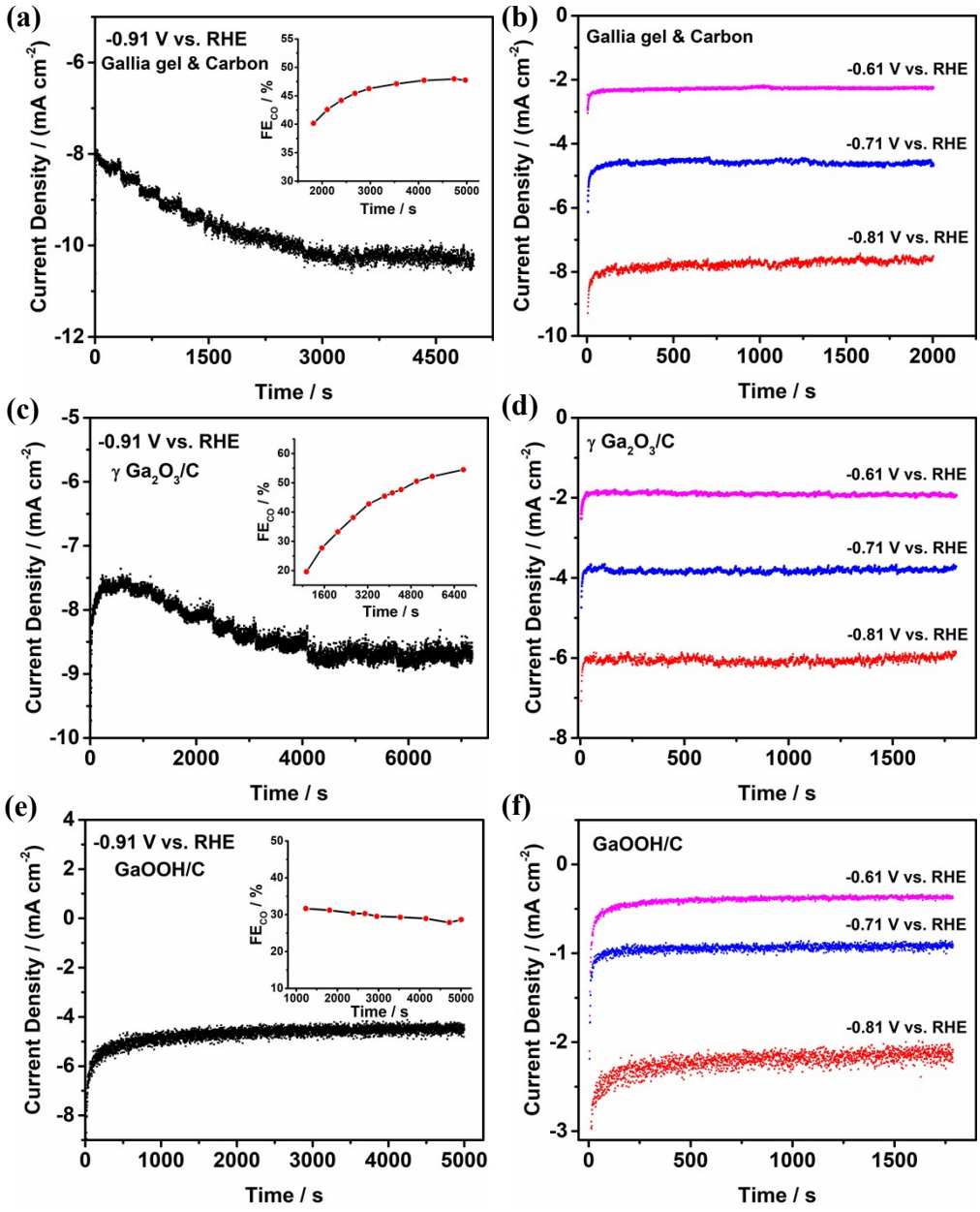

Fig. S7. Cathodic current density profiles for (a) gallia gel mixed with carbon electrode, (c) γ Ga_2O_3/C electrode and (e) GaOOH/C electrode for the initial test at -0.91 V vs. RHE, insets show the variation of CO Faradaic efficiency during the corresponding electrolysis time; Corresponding I-t curves at other potentials after activation at -0.91 V vs. RHE for (b) gallia gel mixed with carbon electrode, (d) γ Ga_2O_3/C electrode and (f) GaOOH/C electrode.

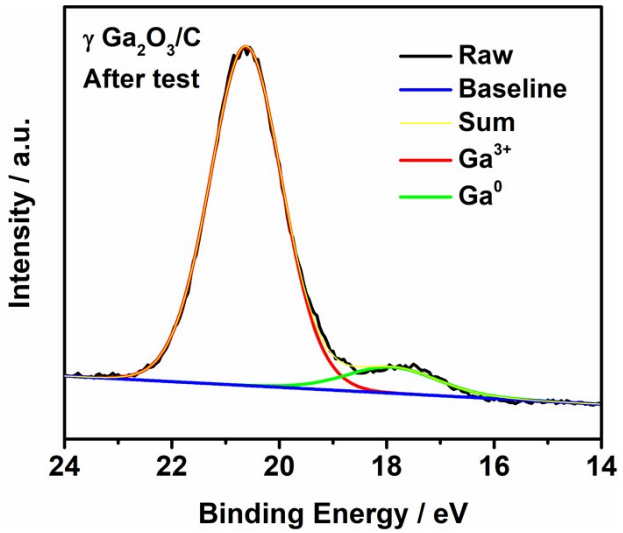

Fig. S8. Ga 3d high-resolution XPS spectrum of γ Ga_2O_3/C electrode collected after CO_2RR measurements.

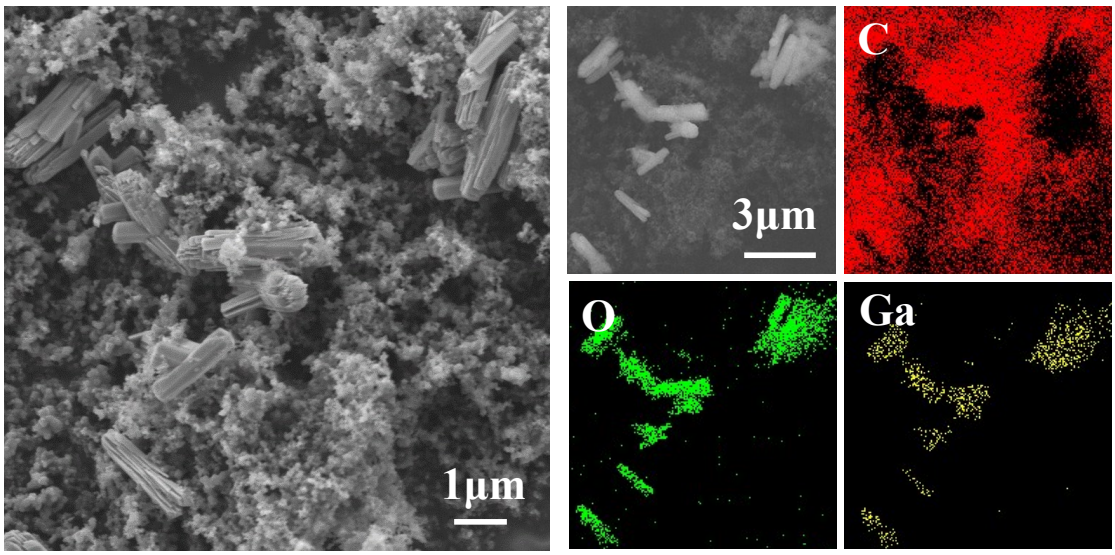

Fig. S9. SEM image and corresponding EDS Mappings for GaOOH/C.

Table S1. Comparison with reported Ga-based catalysts for CO_2RR

Electrode	Potential(V) vs. Ag/AgCl	Current density (mA cm^{-2})	f_{CO}%	f_{HCOO^-}%	f_{H2}%	Electrolyte
Gallia gel/C this work	-1.52	10.7	65.0	0	35.0	0.1 M $KHCO_3$
Gallia gel/C this work	-1.32	4.8	77.0	0	23.0	0.1 M $KHCO_3$
Ga[1]	-1.64	5.0	23.2	0	79.0	0.1 M $KHCO_3$
Ga[2]	-1.60	4.5	5.9	0	91.0	0.1 M $KHCO_3$
Si-doped Ga_2O_3[3]	-1.80	< 1	0.7	88.9	9.3	3.0 M KCl

References

1. Y. Hori, H. Wakebe, T. Tsukamoto and O. Koga, *Electrochim. Acta*, 1994, 39, 1833-1839.
2. N. Hidetomo, I. Shoichiro, O. Yoshiyuki, I. Kazumoto, M. Masunobu and I. Kaname, *Bull. Chem. Soc. Jpn.*, 1990, 63, 2459-2462.
3. T. Sekimoto, M. Deguchi, S. Yotsuhashi, Y. Yamada, T. Masui, A. Kuramata and S. Yamakoshi, *Electrochem. Commun.*, 2014, 43, 95-97.