Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supporting Information

Simple preparation of carbon-bimetal oxide nanospinels for high-performance bifunctional oxygen electrocatalysts

K. Malaie,[*a] C. Jeyabharathi,[b] H. Wulff,[c] M. R. Ganjali,[a] F. Soavi,[d] and F. Scholz[b]

[a] Center of Excellence in Electrochemistry, School of Chemistry, College of Science, University of Tehran, Enghelab St., 1417614411, Tehran, Iran

[b]Institute of Biochemistry, University of Greifswald, Felix-Hausdorff-Str. 4, 17487, Greifswald, Germany

[c]Institute of Physics, University of Greifswald, Felix-Hausdorff-Str. 6, 17489, Greifswald, Germany

[d]Department of Chemistry "Giacomo Ciamician", Alma Mater Studiorum- Università di Bologna, Via Selmi 2, 40126, Bologna, Italy

*Corresponding author. E-mail address: K.malaie@ut.ac.ir

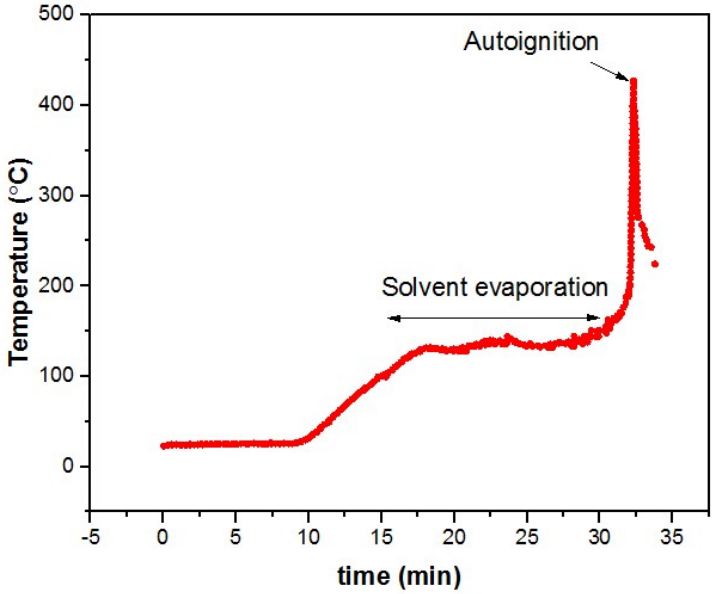

Fig. S1. Temperature profile of the reactor solution recorded by a pyrometer connected to a computer

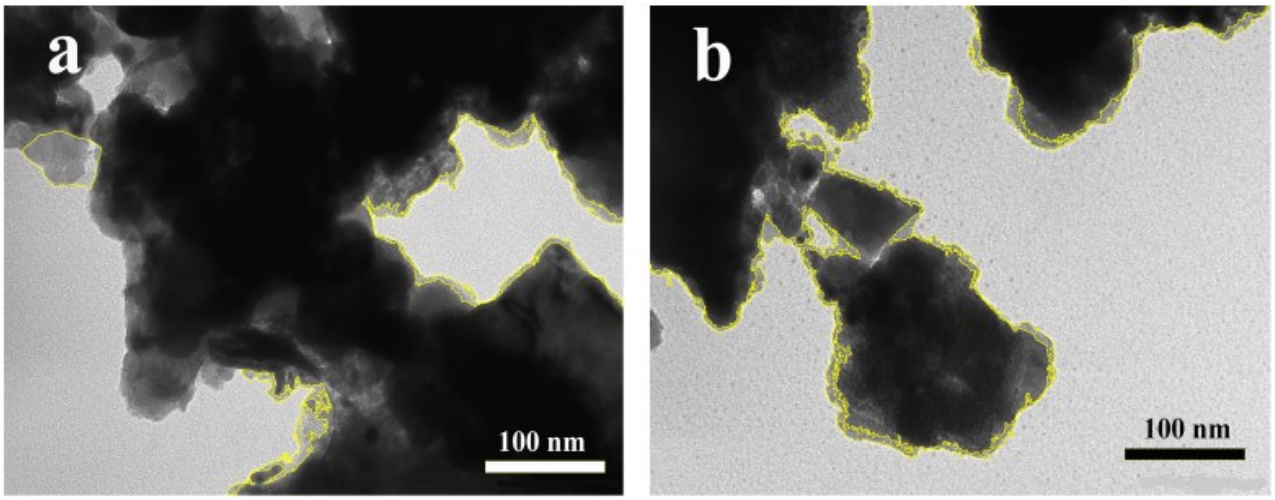

Fig. S2. TEM images of C-CoFe oxide (a) and C-NiFe oxide (b). Highlighted regions show carbon

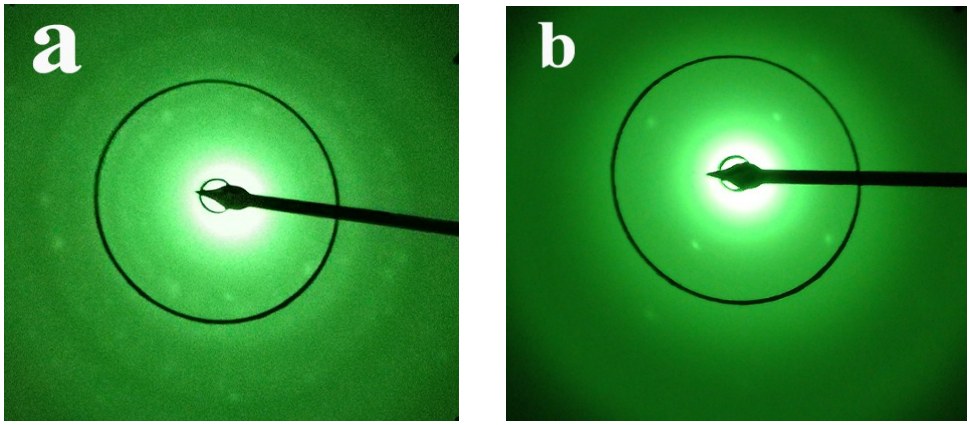

Fig. S3. SAED images of CoFe-oxide (a) and NiFe-oxide (b). They show two rings for C-CoFe oxide and one ring for C-NiFe oxide, confirming the presence of crystalline Co/Fe and Ni/Fe magnetite phases.

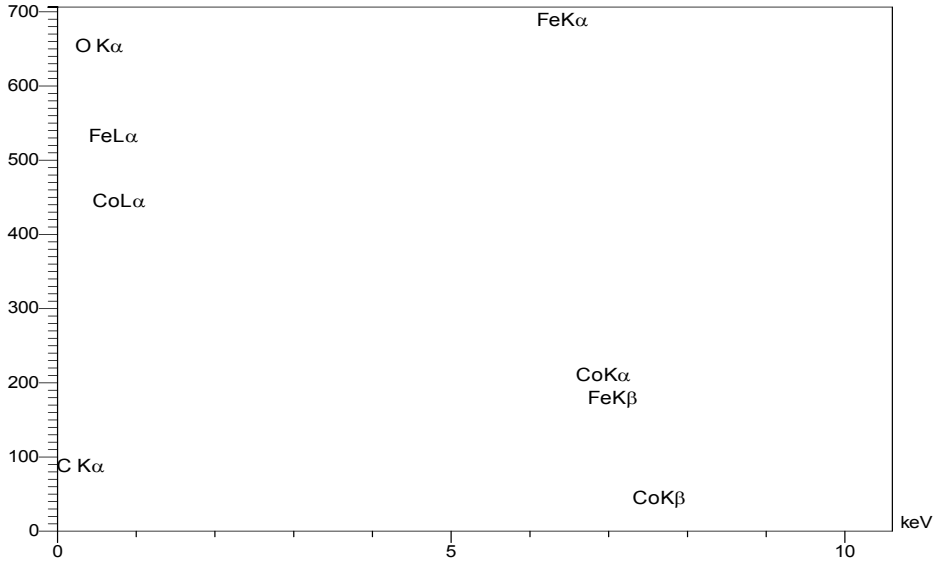

Fig. S4. Energy-dispersive X-ray analysis of C-CoFe oxide

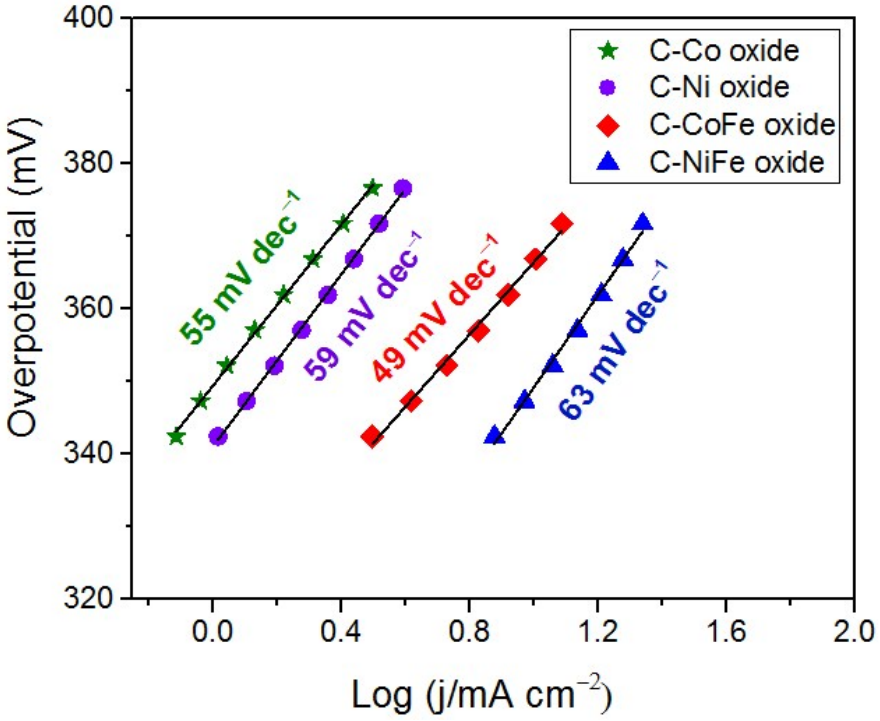

Fig. S5. Tafel plots obtained from the LSVs at 5 mV s^{-1} for the electrocatalysts.

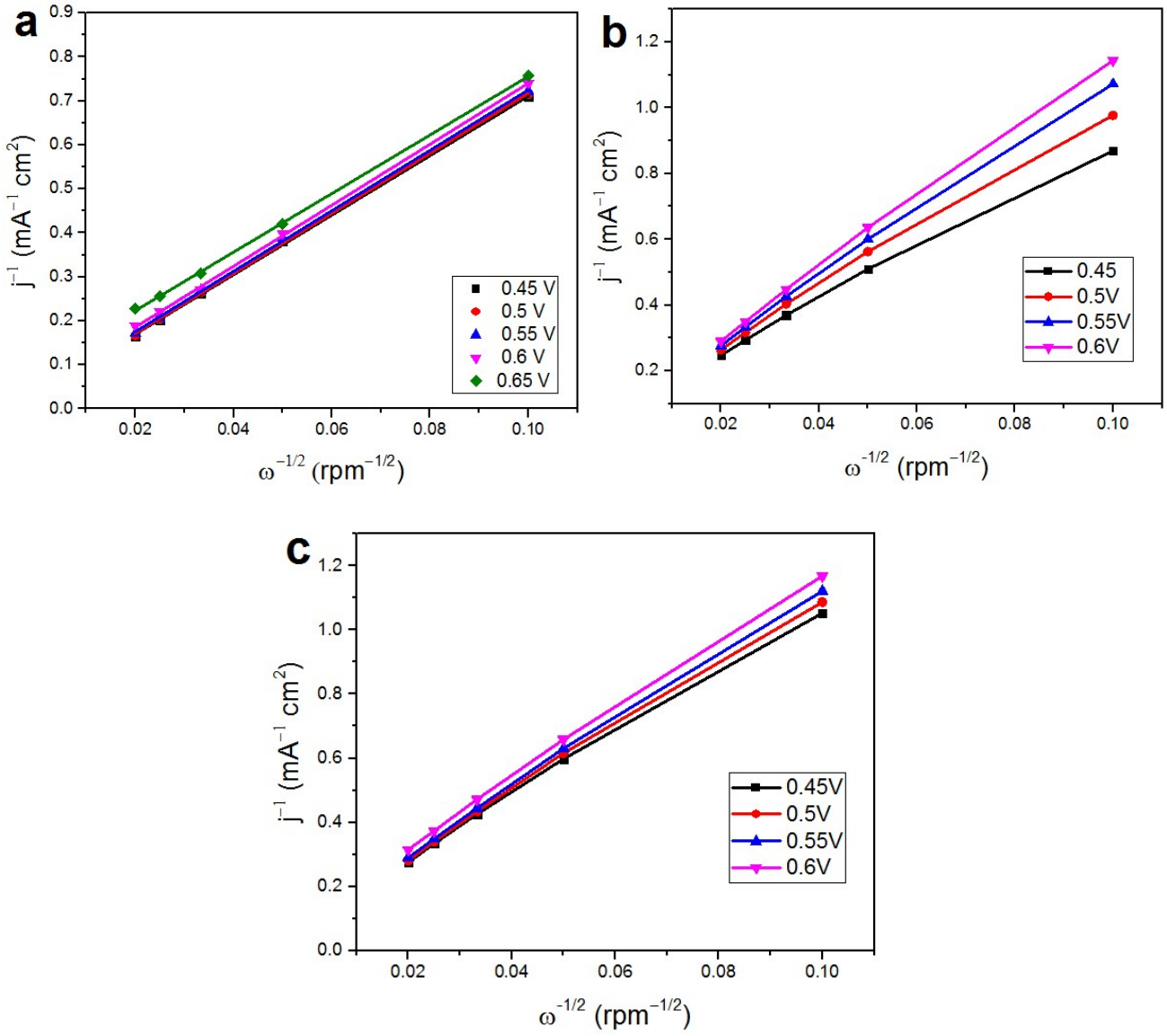

Fig. S6. Koutechy-Levich plots obtained at different potentials for C-Co oxide (a), C-NiFe oxide (b), and C-Ni oxide mixed with 80% Vulcan XC72 carbon.

Table S1. Calculated electron transfer number (n) based on Koutecky-Levich plots at different potentials for ORR on the electrocatalysts

	n_1 (0.45 V)	n_2 (0.5 V)	n_3 (0.55 V)	n_4 (0.6 V)
C-CoFe oxide	4.04	3.90	3.84	3.81
C-Co oxide	4.17	4.11	4.08	4.05
C-NiFe oxide	3.66	3.18	2.84	2.65
C-Ni oxide	2.92	2.81	2.72	2.65

Table S2. Calculated k_f at two different potentials, and the kinetic parameters of α *and* k^0 for the ORR on C-CoFe oxide and C-Co oxide

	k_f *at 0.65 V* ($cm\ s^{-1}$)	k_f *at 0.6 V* ($cm\ s^{-1}$)	α	k^0 ($cm\ s^{-1}$)
C-CoFe oxide	1.93×10^{-2}	2.89×10^{-2}	*0.205*	1.74×10^{-4}
C-Co oxide	2.3×10^{-2}	4.48×10^{-2}	*0.33*	1.27×10^{-5}