

Electronic supplementary information (ESI) for RSC Advances

N-doped zeolite-templated carbon as metal-free electrocatalyst for oxygen reduction

Yonghyun Kwon^{a,b}, Kyoungsoo Kim^b and Ryong Ryoo^{a,b,*}

^a*Department of Chemistry, Korea Advanced Institute of Science and Technology (KAIST), Daejeon 34141, Republic of Korea*

^b*Center for Nanomaterials and Chemical Reactions, Institute for Basic Science (IBS), Daejeon 34141, Republic of Korea*

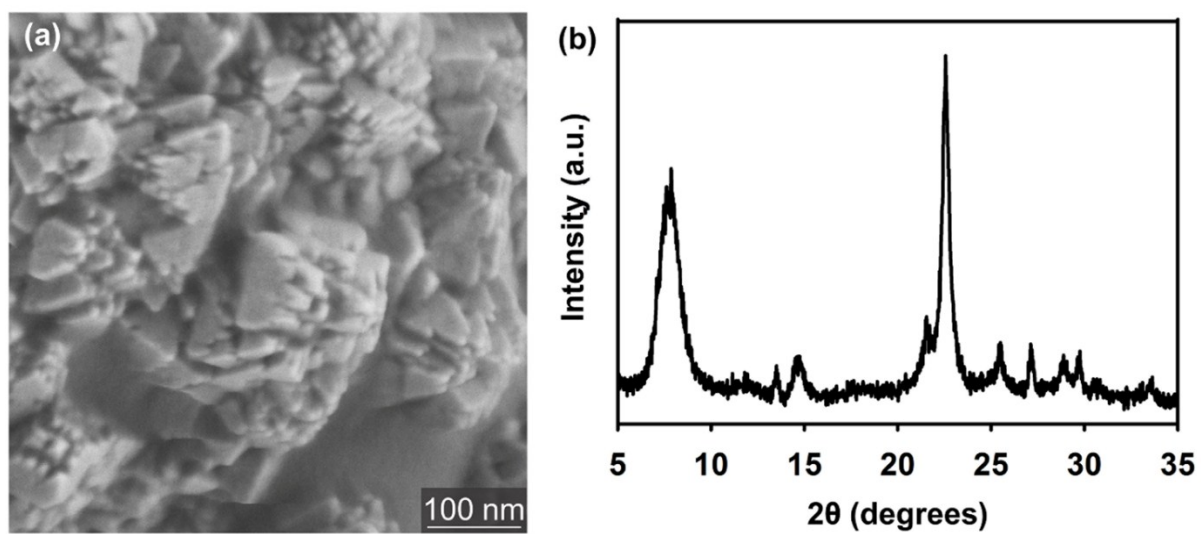


Fig. S1 (a) SEM image and (b) Powder XRD pattern of the beta-zeolite used as a template for carbon synthesis.

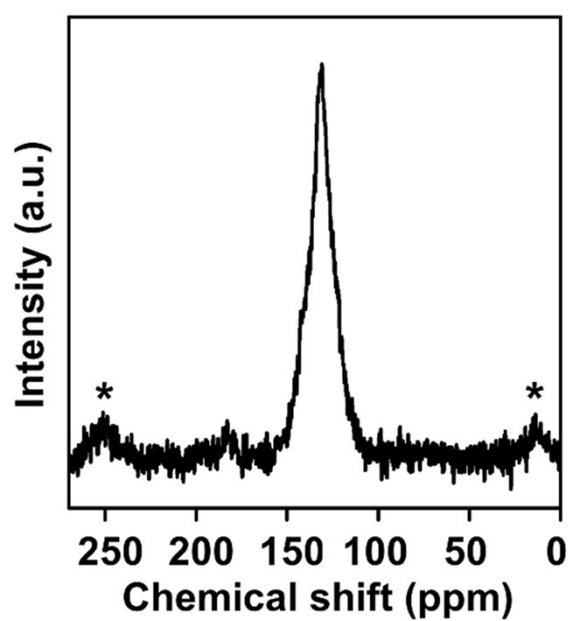


Fig. S2 Solid-state ^{13}C CP MAS NMR spectrum of N-ZTC.

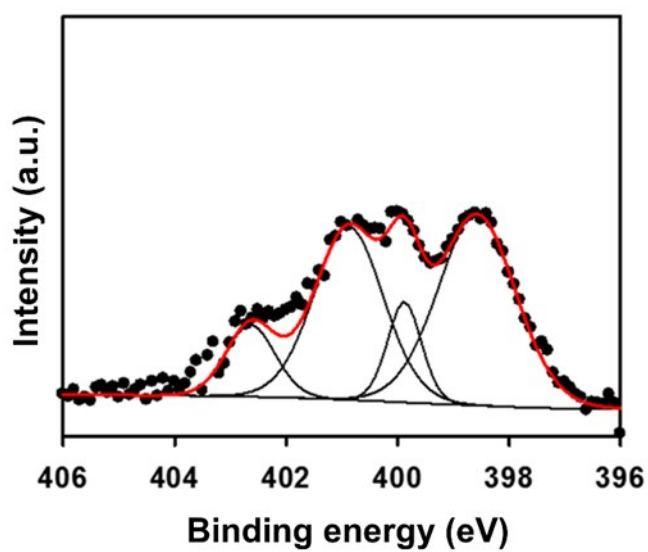


Fig. S3 N_{1s} XPS spectrum of N-ZTC synthesized with anhydrous acetonitrile.

Precursor	Total N [wt%]	Graphitic-N [%]	Pyridinic-N [%]	Pyrrolic-N [%]	Oxide-N [%]
Aqueous CH_3CN	4.1 (3.8*)	54	20	15	11
Anhydrous CH_3CN	4.2 (4.3*)	35	45	10	10

Table S1 XPS quantitative analysis of N species in N-ZTC synthesized with aqueous and anhydrous acetonitrile. (*The numbers in the round brackets are measured by elemental analysis.)

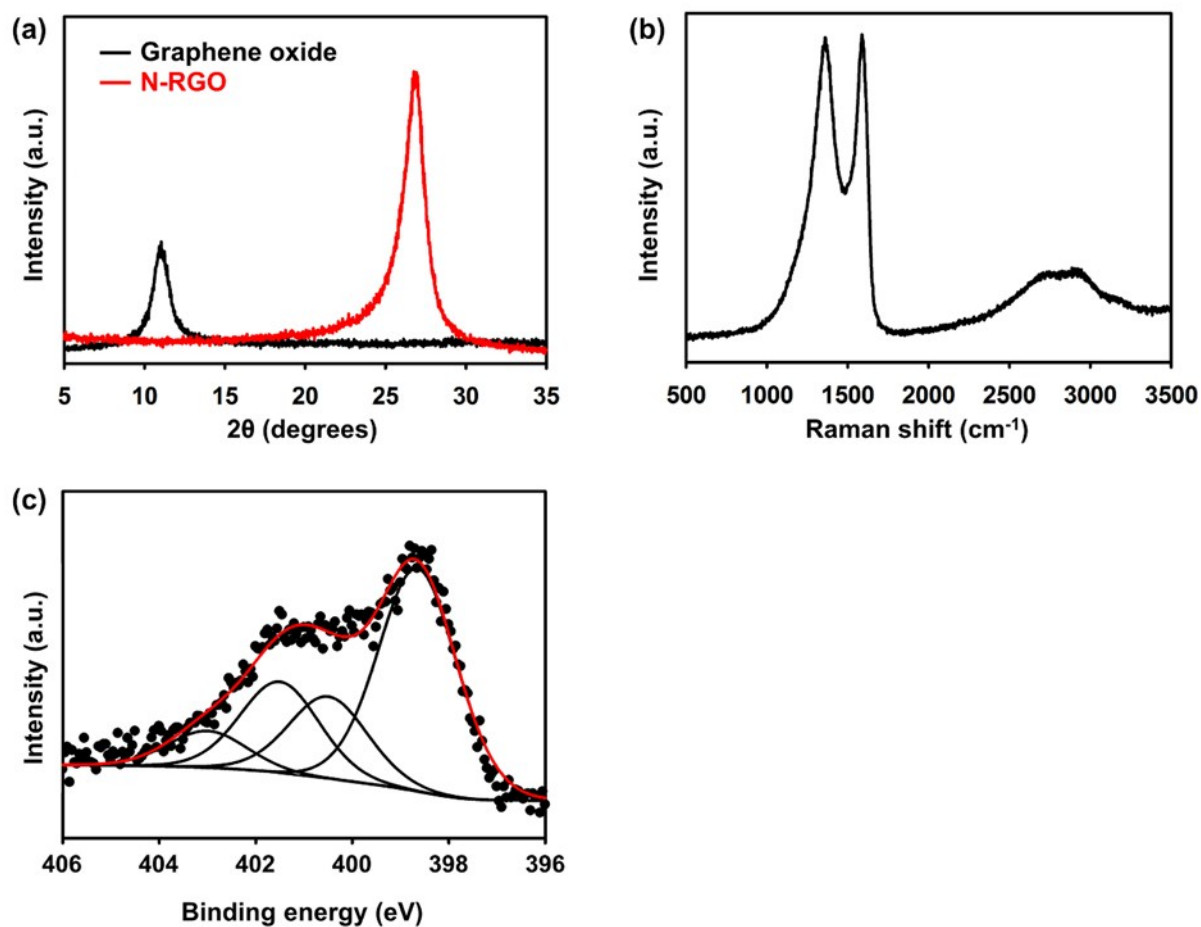


Fig. S4 (a) Powder XRD patterns of graphene oxide and N-RGO, (b) Raman spectrum and (c) N_{1s} XPS spectrum of N-RGO.

Sample	Total N [wt%]	Graphitic-N [%]	Pyridinic-N [%]	Pyrrolic-N [%]	Oxide-N [%]
N-RGO	4.3 (4.2*)	21	51	19	9

Table S2 XPS quantitative analysis of N species in N-RGO. (*The numbers in the round brackets are measured by elemental analysis.)

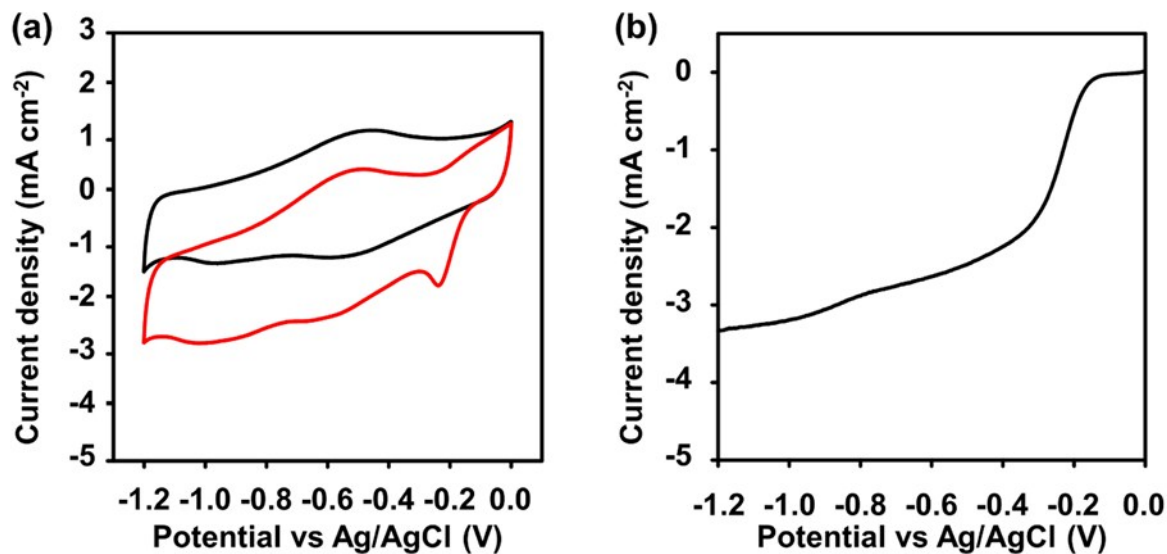


Fig. S5 (a) CV curves of ZTC modified electrodes in an O_2 (Red line) and N_2 (Black line)-saturated 0.1 M KOH at a scanning rate of $100\ mV\ s^{-1}$, (b) ORR polarization curve of ZTC in an O_2 -saturated 0.1 M KOH with rotating rate of 1600 rpm at a scanning rate of $10\ mV\ s^{-1}$.

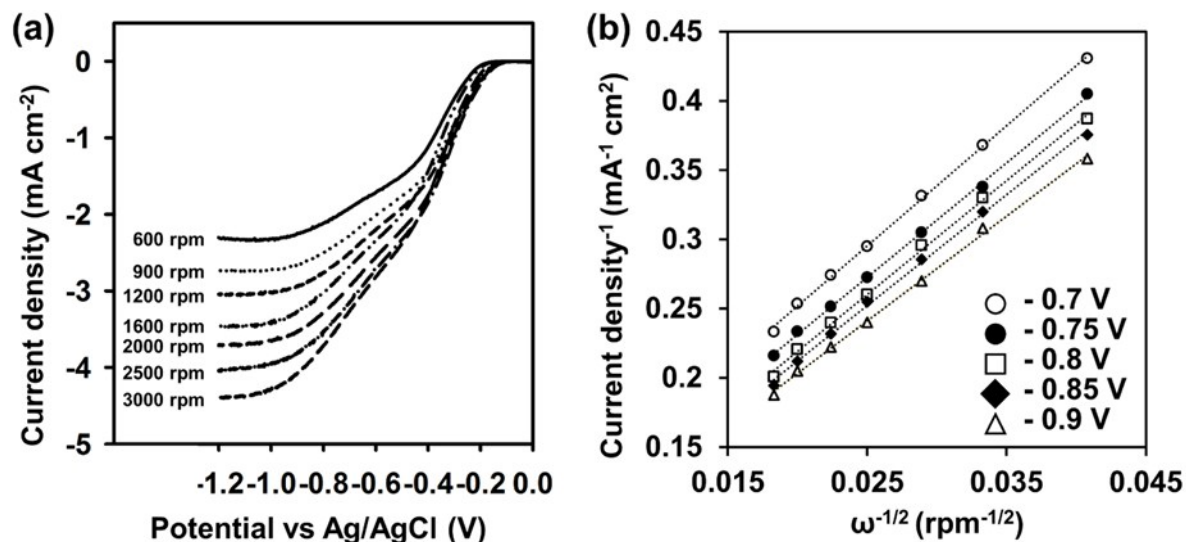


Fig. S6 (a) RDE curves and (b) K-L plots of N-RGO in an O_2 -saturated 0.1 M KOH with different disk rotating rates at a scanning rate of $10\ mV\ s^{-1}$.

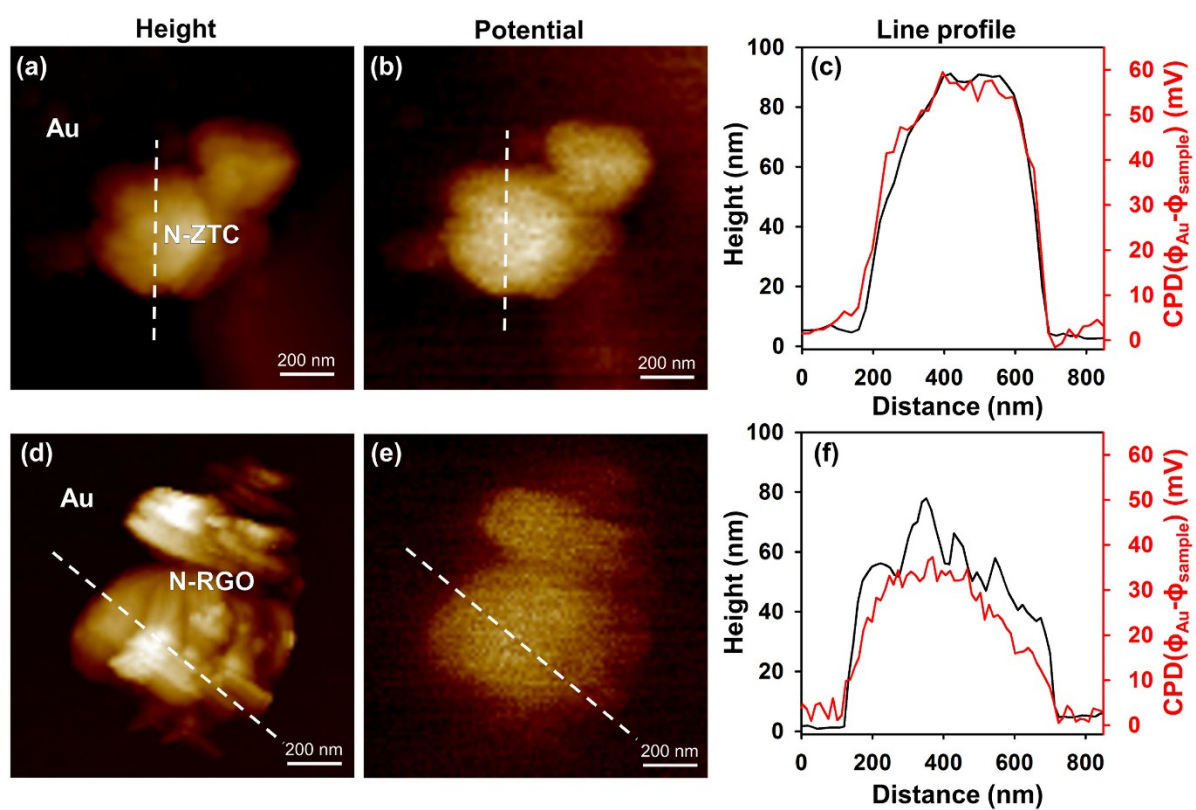


Fig. S7 KPFM measurements on N-ZTC and N-RGO surface. (a,d) Topographic images, (b,e) CPD images and (c,f) line profiles along the dashed lines of N-ZTC (top) and N-RGO (bottom).