

## **Supporting Information**

### **B,N,S tri-doped Reduced Graphite Oxide-Cobalt Oxide Composite: A Bifunctional Electrocatalyst for Enhanced Oxygen Reduction and Oxygen Evolution Reaction**

Sagar B. Ingavale,<sup>[a]</sup> Indrajit M. Patil,<sup>[a,b]</sup> Haridas B. Parse<sup>[a,b]</sup> Niranjan Ramgir,<sup>[c]</sup> Bhalchandra  
Kakade,<sup>[a,b]\*</sup> and Anita Swami<sup>[a]\*</sup>

<sup>a</sup>Department of Chemistry, SRM Institute of Science & Technology, Kattankulathur – 603203,  
Chennai (India)

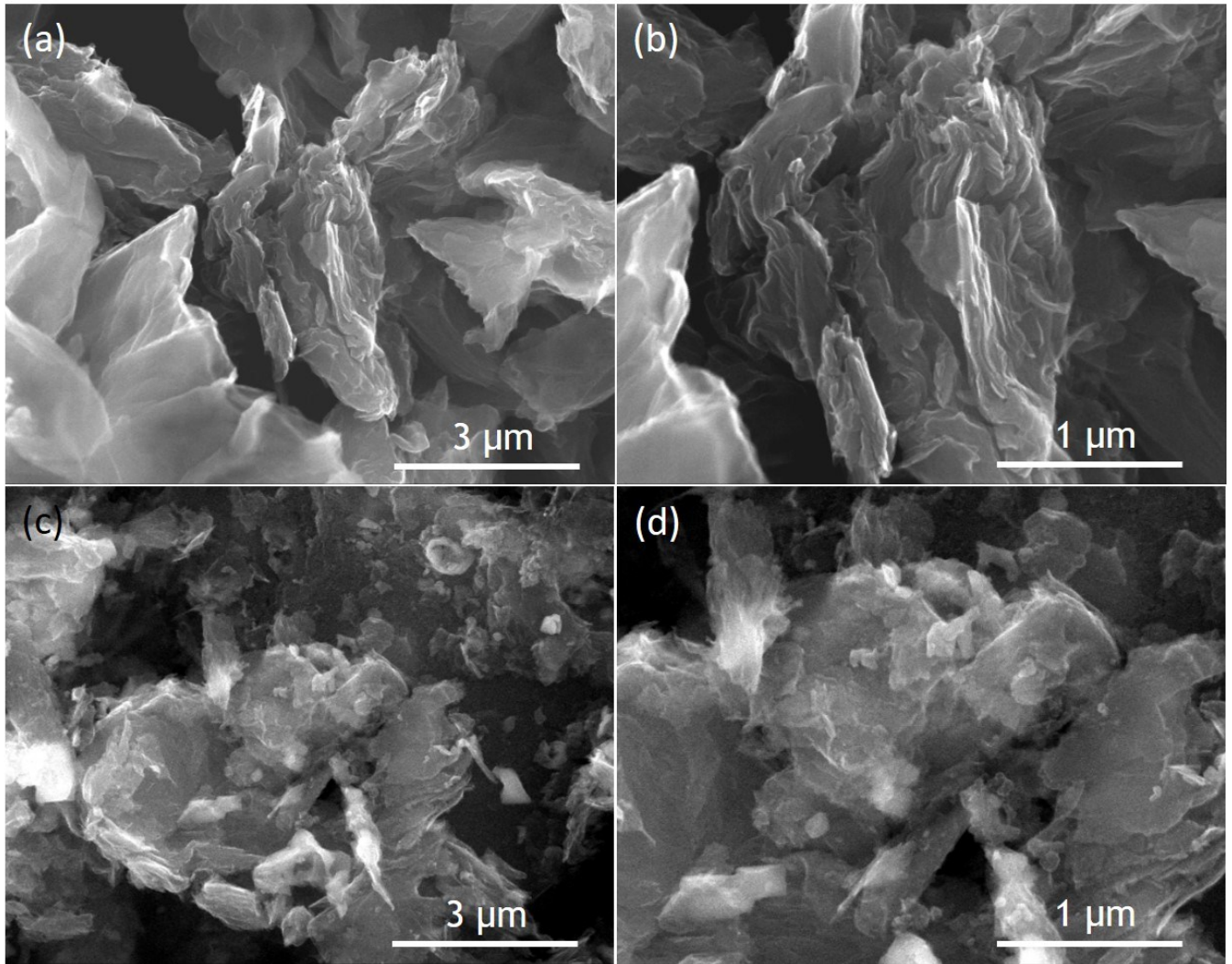
<sup>b</sup>SRM Research Institute, SRM Institute of Science & Technology, Kattankulathur – 603203,  
Chennai (India)

FAX: (+91) 44-2745 6702; Tel: (+91) 44-2741 7920

<sup>c</sup>Technical Physics Division, Bhabha Atomic Research Center, Mumbai – 400 085 (India)

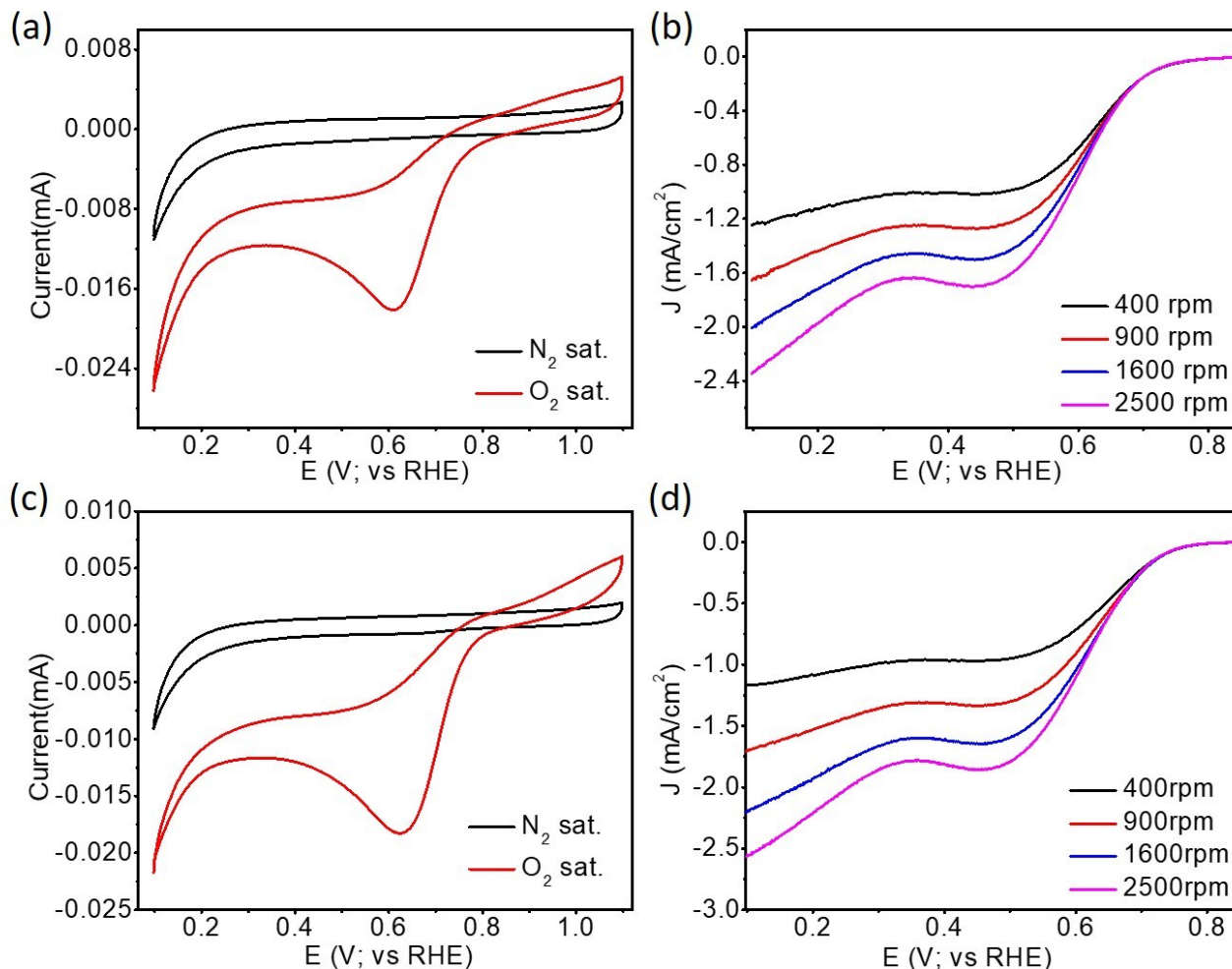
\*Corresponding author E-mail: [swamianita.s@ktr.srmuniv.ac.in](mailto:swamianita.s@ktr.srmuniv.ac.in)

**Figure S1**



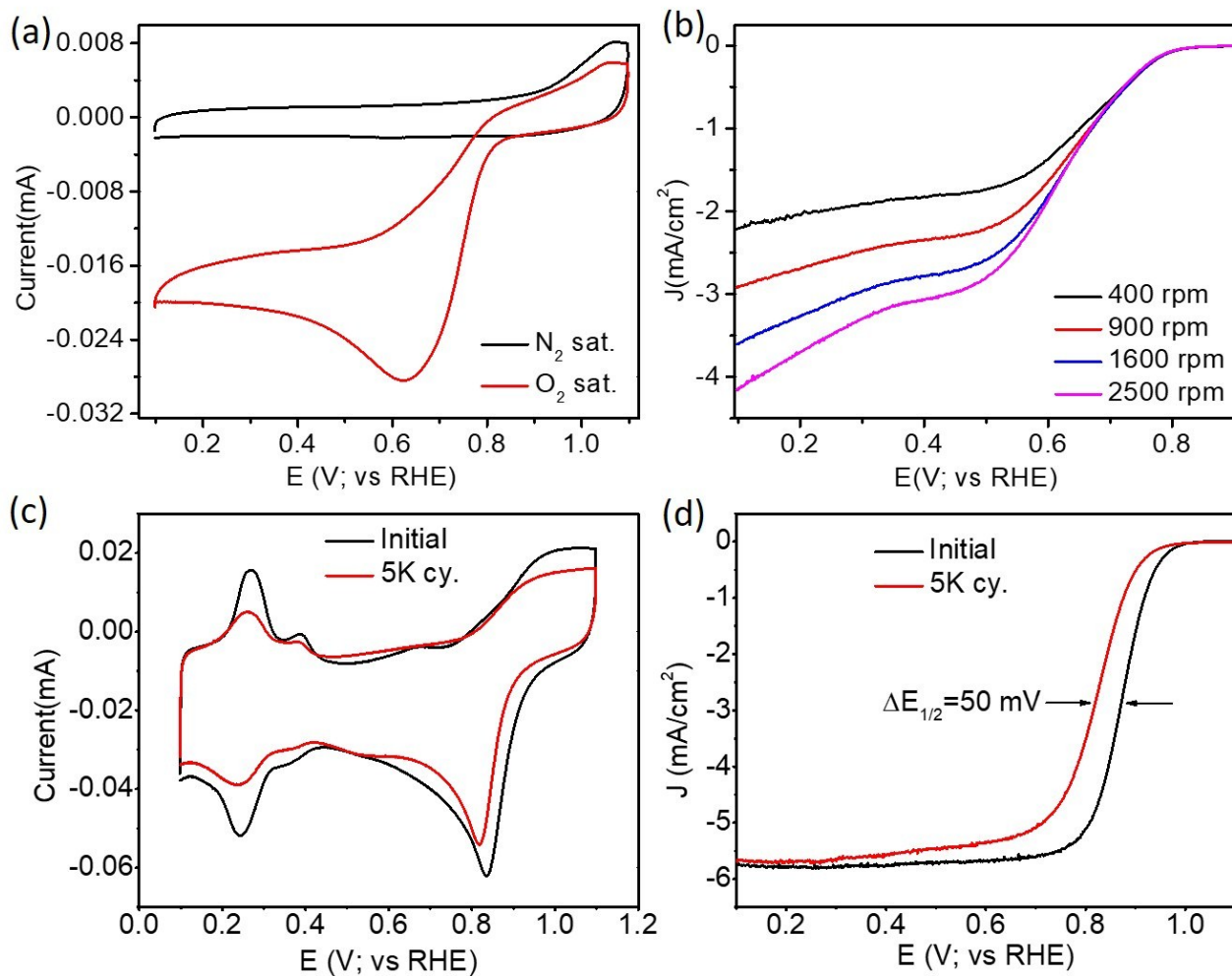
**Figure S1:** Low and high resolution SEM images of (a-b) NS/GO and (c-d) NS/rGO-Co7

Figure S2



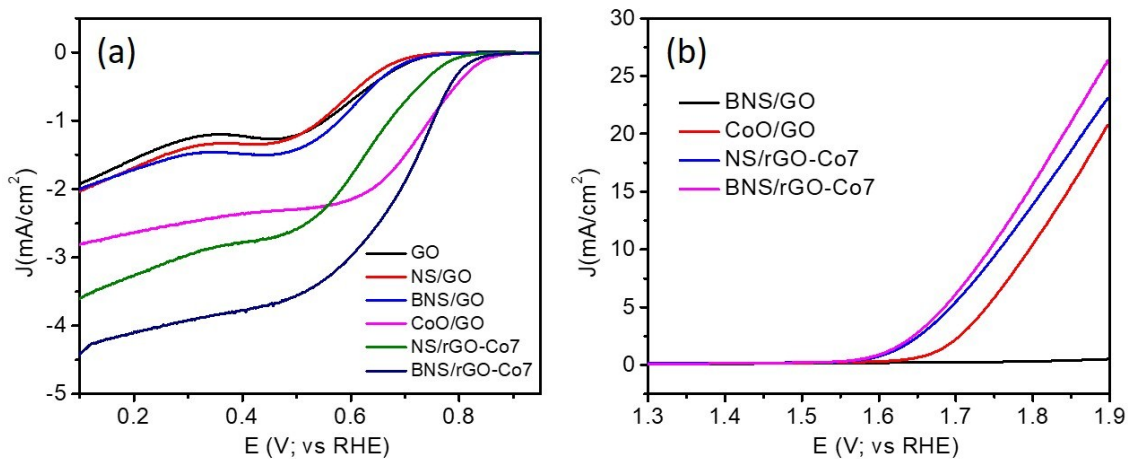
**Figure S2:** (a) Comparative CVs of BNS/GO in N<sub>2</sub> and O<sub>2</sub>-saturated 0.1 M KOH at a scan rate of 20 mV s<sup>-1</sup>; (b) LSV of BNS/GO catalyst under O<sub>2</sub>-saturated 0.1 M KOH recorded at various rotation speeds at scan rate 10 mV s<sup>-1</sup>; (c) comparative CVs of NS/GO in N<sub>2</sub> and O<sub>2</sub>-saturated 0.1 M KOH at a scan rate of 20 mV s<sup>-1</sup>; (d) LSV of NS/GO catalyst under O<sub>2</sub>-saturated 0.1 M KOH recorded at various rotation speeds at scan rate 10 mV s<sup>-1</sup>;

Figure S3



**Figure S3:** (a) Comparative CVs of NS/rGO-Co7 in N<sub>2</sub> and O<sub>2</sub>-saturated 0.1 M KOH at a scan rate of 20 mV s<sup>-1</sup>; (b) LSV of NS/rGO-Co7 catalyst under O<sub>2</sub>-saturated 0.1 M KOH recorded at various rotation speeds at scan rate 10 mV s<sup>-1</sup>; (c) comparative CV curves of commercial Pt/C catalyst before and after 5000 durability cycles in N<sub>2</sub> saturated 0.1 M KOH with scan rate 100 mV/s; (d) comparative LSV curves of commercial Pt/C at 1600 rpm with scan rate 10 mV/s before and after 5000 durability cycles;

**Figure S4**



**Figure S4** (a) Comparative LSVs of various catalysts under  $O_2$ -saturated 0.1 M KOH, recorded at various rotation speeds at 25 °C (geo: geometric current density, scan rate 10 mV s<sup>-1</sup>); (b) comparative OER voltammograms of BNS/GO, CoO/GO, NS/rGO-Co7 and BNS/rGO-Co7 at 1600 rpm with scan rate of 10 mV/s;

**Table S1: Comparison of ORR activities of various prepared electrocatalysts**

<b>Catalyst</b>	<b>Onset Potential (V vs RHE)</b>	<b>E<sub>1/2</sub> (V; vs RHE)</b>	<b>Mass Activity (mA/mg)</b>
BNS/GO	0.76	0.61	43
BNS/rGO-Co4	0.81	0.44	48
<b>BNS/rGO-Co7</b>	<b>0.87</b>	<b>0.70</b>	<b>155</b>
BNS/rGO-Co15	0.84	0.63	84
BNS/rGO-Co25	0.82	0.61	62
BNS/rGO-Co50	0.84	0.59	48

**Table S2: Comparison of catalytic performance of various electrocatalysts**

Catalyst	Catalyst loading (mg/cm <sup>2</sup> )	ORR activities		OER activities			Reference
		Onset potential (V)	Current Density (mAcm <sup>-2</sup> )	Electrolyte KOH (M)	Over potential at 10 mA cm <sup>-2</sup>	Onset potential vs RHE	
Comm. Pt/C	0.113	1.02	5.8	0.1	410	1.66	Present study
Pt-NB/G	0.102	1.08	5.5	0.1	-	-	1
Pt2Pd/NPG 700	0.159	0.98	4.1	0.1	-	-	2
Comm. RuO <sub>2</sub>	-	-	-	1.0	377	-	3
RuO <sub>2</sub> /Co <sub>3</sub> O <sub>4</sub>	0.285	N/A	N/A	1.0	305	N/A	4
RuO <sub>2</sub>	0.255	-	-	0.1	670	1.51	5
IrO <sub>2</sub>	0.255	-	-	0.1	750	1.57	5
N-GQDs/Co <sub>3</sub> O <sub>4</sub>	0.70	0.698	2.3	0.1	330	1.55	6
Co <sub>3</sub> O <sub>4</sub> /NRGO	0.211	0.89	3.6	1.0	420	N/A	7
Co <sub>3</sub> ZnC/Co@CN	0.344	0.81	3.7	1.0	366	N/A	3
CoS <sub>2</sub> (400)/N,S-GO	0.25	0.97	4.4	0.1	380	N/A	8
N-CG-CoO	0.70	0.9	1.7	1.0	340	1.30	9
<b>BNS/rGO-Co7</b>	<b>0.113</b>	<b>0.87</b>	<b>4.4</b>	<b>0.1</b>	<b>510</b>	<b>1.58</b>	<b>Present study</b>