Supporting Information

Three-Dimensional B, N-doped Graphene Foam as Metal-free Catalysts for Oxygen Reduction Reaction

Yuhua Xue, a,b,‡ Dingshan Yu, b,‡ Liming Dai, b,a,*, Ruigang Wang, c Dingqiang Li, c Ajit Roy, d
Fan Lu, a Hao Chen, a Yong Liu, a,* and Jia Qu, a,*

a Institute of Advanced Materials for Nano-Bio Applications, School of Ophthalmology & Optometry, Wenzhou Medical College, 270 Xueyuan Xi Road, Wenzhou, Zhejiang 325027, China. E-mails: yongliu1980@hotmail.com; jia.qu@163.com

b Center of Advanced Science and Engineering for Carbon (Case4Carbon), Department of Macromolecular Science and Engineering, Case Western Reserve University, Cleveland, Ohio 44106, USA. Emails: liming.dai@case.edu

c Department of Chemistry, Youngstown State University, One University Plaza, Youngstown, Ohio 44555 (USA)

d Thermal Science and Materials Branch, Materials&Manufacturing Directorate, Air Force Research Laboratory, Dayton, OH 45433 (USA)

‡ These authors contributed equally to this work.
Figure S1. Raman spectra of GF, N-GF, B-GF and BN-GF.
Figure S2. CV curves of glass carbon, GF, B-GF, N-GF and BN-GF in 5 mM K$_3$Fe(CN)$_6$/0.1 M KCl solution. Scan rate: 50 mV s$^{-1}$.

The electroactive surface area can be calculated according to the Randles-Sevcik equation as follows:

$$A = \frac{I_p}{2.69 \times 10^5} n^{3/2} D^{1/2} V^{1/2} C$$

A is electroactive surface area (cm$^2$), $I_p$ is peak current (A), and $n=1$, $D=4.34 \times 10^{-6}$, $V$ is scan rate (V/s), $C$ is concentration. The electroactive surface area of different graphene foam is calculated and listed in the following foam. B or N doping can increase the electroactive surface area.

<table>
<thead>
<tr>
<th>electrode</th>
<th>Glass carbon</th>
<th>GF</th>
<th>B-GF</th>
<th>N-GF</th>
<th>BN-GF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface area (cm$^2$)</td>
<td>0.19</td>
<td>0.70</td>
<td>0.76</td>
<td>0.84</td>
<td>0.99</td>
</tr>
</tbody>
</table>