Supporting Information

Highly Efficient Oxygen Evolution Reaction in Rechargeable Lithium-Oxygen Batteries with Triethylphosphate-Based Electrolytes

Shoichi Matsuda, †‡ *, Hitoshi Asahina†‡

†Center for Green Research on Energy and Environmental Materials, National Institute for Material Science, 1-1 Namiki, Tsukuba, Ibaraki 305-0044, Japan
‡NIMS-SoftBank Advanced Technologies Development Center, National Institute for Material Science, 1-1 Namiki, Tsukuba, Ibaraki 305-0044, Japan
Table S1

Physical properties of electrolytes investigated in the present study

<table>
<thead>
<tr>
<th>Electrolyte</th>
<th>Conductivity(\text{mS/cm})</th>
<th>Viscosity(\text{mPa s})</th>
<th>Density(\text{g/cm}^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 M LiNO(_3) in TEP</td>
<td>2.6</td>
<td>3.8</td>
<td>1.11</td>
</tr>
<tr>
<td>3 M LiNO(_3) in TEP</td>
<td>1.1</td>
<td>26.9</td>
<td>1.18</td>
</tr>
<tr>
<td>1 M LiTFSI in TEP</td>
<td>5.1</td>
<td>3.6</td>
<td>1.17</td>
</tr>
<tr>
<td>1 M LiTFSI + 1 M LiNO(_3) in TEP</td>
<td>2.4</td>
<td>13.1</td>
<td>1.22</td>
</tr>
</tbody>
</table>
**Figure S2**

*In situ* MS analysis of Li–O₂ cells with electrolytes of (a) 1 M LiNO₃ in TEGDME and (b) 3 M LiNO₃ in TEGDME. The experiments employed a current density of 0.1 mA/cm². The theoretical value of oxygen evolution efficiency is shown as dotted line.
Figure S3

Liner sweep voltammogram of electrochemical cells with electrolytes of 3 M LiNO$_3$ in TEP. The experiments employed a current density of 0.003 mV/s.
**Figure S4**

*In situ* MS analyses of Li–O₂ cells with $^{13}$C/$^{12}$C composite electrode using 3 M LiNO₃ in TEP as electrolyte. The experiments employed a current density of 0.1 mA/cm². The theoretical value of oxygen evolution efficiency is shown as dotted line.
In situ MS analysis of Li–O$_2$ cells with electrolytes of 3 M LiNO$_3$ in TEP with (a) 10$^{th}$ and (b) 20$^{th}$ charging process. The experiments employed a current density of 0.1 mA/cm$^2$. The theoretical value of oxygen evolution efficiency is shown as dotted line.
**Figure S6**

SEM analysis of the carbon electrodes removed from the Li–O₂ cells with the electrolyte of 3 M LiNO₃ in TEP (a) before, (b) after 10ᵗʰ and (c) after 40ᵗʰ charging processes.
Figure S7

LC-MS analysis of 3 M LiNO$_3$ in TEP electrolyte removed from the Li–O$_2$ cell after the 40$^{th}$ charging process.
Figure S8

Li deposition/dissolution cycles of Ni/Li cell with electrolyte of 3 M LiNO₃ in TEP. The current density was set to 0.5 mA/cm² with capacity limitation of 1.0 mAh/cm².
Figure S9

SEM image of the Li metal electrode that taken out from Li–O$_2$ cell with electrolyte of 3 M LiNO$_3$ in TEP after the 40$^{th}$ discharge/charge cycle.