Insights into autonomously formed oxygen-evacuated Cu$_2$O electrode for the selective production of C$_2$H$_4$ from CO$_2$

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Figure S1. Schematic diagram of the H-type cell used for the electrochemical CO$_2$ reduction.
Figure S2. Faradaic efficiencies for all products; H$_2$ (◇), CO (▲), HCOO$^-$ (▽), CH$_4$ (■), and C$_2$H$_4$ (●) on (a) Cu$_2$O and (b) Cu at different applied potentials. CO$_2$ electrolysis was performed for 30 min at each potential in a CO$_2$-saturated 0.5 M KHCO$_3$ solution.
Figure S3. Current density profiles of (a) Cu$_2$O and (b) Cu during CO$_2$ electrolysis for 2 h.
Figure S4. Partial current densities during CO$_2$ electrolysis of (a) Cu$_2$O and (b) Cu for 2 h. H$_2$ (◇), CO (▲), HCOO$^-$ (▽), CH$_4$ (■), and C$_2$H$_4$ (●).
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<tr>
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<th>Capacitance (mF)</th>
<th>Surface roughness factor</th>
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<tbody>
<tr>
<td>Cu</td>
<td>0.36</td>
<td>1</td>
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<tr>
<td>Cu$_2$O</td>
<td>0.87</td>
<td>2.42</td>
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**Figure S5.** Cyclic voltammograms (CVs) for the measurement of the surface roughness factor on Cu$_2$O (a) and Cu (b) electrodes in 0.1 M HClO$_4$ at a scan rate of 40 mV s$^{-1}$, with Ar bubbling.
Figure S6. Potential profile during CO$_2$ electrolysis on Cu electrode at a constant current density of 10 mA cm$^{-2}$ for 1 h. Faradaic efficiencies of C$_2$H$_4$ (a), CH$_4$ (b) and H$_2$ (c) were almost same as the product distribution on Cu electrode at constant potential of -1.9 V.
**Figure S7.** SEM images for the Cu electrode (a) before and (b) after CO$_2$ electrolysis and the Cu$_2$O electrode (c) before and (d) after CO$_2$ electrolysis at -1.9 vs. Ag/AgCl.
Figure S8. TEM images for the Cu electrode (a) before and (b) after CO$_2$ electrolysis and the Cu$_2$O electrode (c) before and (d) after CO$_2$ electrolysis at -1.9 vs. Ag/AgCl.
Figure S9. Auger spectra of Cu$_2$O before (a) and after (b) CO$_2$ electrolysis and Cu before (c) and after (d) CO$_2$ electrolysis. CO$_2$ reduction was carried out for 2 h.