**Research Data**

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The research data provides the experimental data of Figure 2-8

Figure 2:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Time(h)** | **Desorption amount(mmol/g)** | | | |
| 1 | 0.8338 | 0.84416 | 0.8523 | 0.85267 |
| 4 | 0.95534 | 1.29297 | 1.29297 | 1.30388 |
| 8 | 1.19547 | 1.41377 | 1.45151 | 1.48944 |
| 16 | 1.26207 | 1.56547 | 1.82725 | 1.8278 |
| 24 | 1.28057 | 1.74159 | 1.84538 | 1.84593 |

Figure 3:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Ratio of OH-/HCO3- at inlet** | | | | | |
| 1 | | 2 | | 4 | |
| **Time**  **(min)** | **Desorption ratio(%)** | **Time**  **(min)** | **Desorption ratio(%)** | **Time**  **(min)** | **Desorption ratio(%)** |
| 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 37.93197 | 5 | 40.49832 | 5 | 51.48661 |
| 8 | 43.5281 | 10 | 51.64023 | 10 | 60.69038 |
| 10 | 46.06514 | 15 | 53.17922 | 15 | 64.87391 |
| 30 | 45.62853 | 20 | 53.97115 | 20 | 68.59 |
| 60 | 45.3 | 30 | 53.87908 | 30 | 69.89415 |
| / | / | 60 | 53.9 | 40 | 69.67 |
| / | / | / | / | 60 | 69.89 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Ratio of OH-/HCO3- at inlet** | | | | | |
| 8 | | 16 | | 24 | |
| **Time**  **(min)** | **Desorption ratio(%)** | **Time**  **(min)** | **Desorption ratio(%)** | **Time**  **(min)** | **Desorption ratio(%)** |
| 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 58.18026 | 5 | 57.84558 | 5 | 57.34356 |
| 10 | 64.61595 | 10 | 68.22073 | 10 | 69.22478 |
| 20 | 73.86 | 20 | 78.76323 | 20 | 89.18437 |
| 30 | 76.42045 | 30 | 84.62017 | 30 | 94.14314 |
| 40 | 78.26121 | 40 | 90.08597 | 40 | 96.39712 |
| 60 | 78.33 | 60 | 98.77024 | 50 | 98.54 |
| / | / | 70 | 98.51 | 60 | 99.7 |
| / | / | / | / | 70 | 99.37 |

Figure 4’s data has shown in Table.1

|  |  |  |  |
| --- | --- | --- | --- |
| **Conditions** | **Kinetics Model** | **Kinetics parameter** | **R2** |
| T = 25 ℃  ratio of OH- / HCO3- = 16  flow rate = 2 mlꞏs-1  alkaline concentration = 1 M | Elovich | *b* = 0.276 mmolꞏmin-1 | 0.998 |
| PSO | *k2* = 0.137 min-1 | 0.985 |
| PFO | *k1* = 0.116 min-1 | 0.932 |
| SCM | *ks* = 0.014 min-1 | 0.906 |

Figure 5:

|  |  |  |  |
| --- | --- | --- | --- |
| **Condition** | | | |
| Soaking | | Disturbance | |
| **Time**  **(min)** | **Desorption amount per area(mmol/cm2)** | **Time**  **(min)** | **Desorption amount per area(mmol/cm2)** |
| 0 | 0 | 0 | 0 |
| 10 | 0.0072 | 5 | 0.00998 |
| 20 | 0.01011 | 10 | 0.01205 |
| 30 | 0.01181 | 20 | 0.01552 |
| 60 | 0.01511 | 30 | 0.01638 |
| 120 | 0.01687 | 40 | 0.017 |
| 180 | 0.01739 | 60 | 0.01735 |
| / | / | 120 | 0.01733 |
| / | / | 180 | 0.01739 |
| / | / | / | / |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Condition** | | | | | |
| Recirculation(1ml/s) | | Recirculation(2ml/s) | | Recirculation(3ml/s) | |
| **Time**  **(min)** | **Desorption amount per area**  **(mmol/cm2)** | **Time**  **(min)** | **Desorption amount per area**  **(mmol/cm2)** | **Time**  **(min)** | **Desorption amount per area**  **(mmol/cm2)** |
| 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 0.00778 | 5 | 0.00889 | 5 | 0.01077 |
| 10 | 0.01073 | 10 | 0.01149 | 10 | 0.01328 |
| 15 | 0.01317 | 15 | 0.01389 | 15 | 0.01538 |
| 20 | 0.01492 | 20 | 0.01587 | 20 | 0.01669 |
| 30 | 0.0158 | 30 | 0.01719 | 30 | 0.01733 |
| 40 | 0.01655 | 60 | 0.01732 | 60 | 0.01731 |
| 60 | 0.01734 | 120 | 0.01736 | 120 | 0.01735 |
| 120 | 0.01735 | 180 | 0.0174 | 180 | 0.0174 |
| 180 | 0.0174 | / | / | / | / |

Figure 6:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Condition** | | | | | |
| Disturbance | | | Recirculation(2ml/s) | | |
| **Ratio of OH-/HCO3- at inlet** | **Utilization rate (%)** | **Desorption ratio (%)** | **Ratio of OH-/HCO3- at inlet** | **Utilization rate (%)** | **Desorption ratio (%)** |
| 1 | 92.13 | 46.07 | 1 | 87.9 | 43.95 |
| 2 | 53.97 | 53.97 | 2 | 52.47 | 52.47 |
| 4 | 34.95 | 69.89 | 4 | 32.17 | 64.35 |
| 8 | 19.57 | 78.33 | 8 | 17.52 | 70.1 |
| 16 | 12.35 | 98.77 | 12 | 12.98 | 77.89 |
| 24 | 8.31 | 99.7 | 16 | 10.95 | 87.62 |
| / | / | / | 20 | 9.95 | 99.47 |
| / | / | / | 24 | 8.33 | 99.96 |

Figure 7:

|  |  |  |
| --- | --- | --- |
| **Ratio of OH-/HCO3- at inlet** | **Utilization Rate(%)** | |
| Recirculation | Disturbance |
| 1 | 87.9 | 92.13 |
| 2 | 52.47 | 53.97 |
| 4 | 32.17 | 34.95 |
| 8 | 17.52 | 19.57 |
| 12 | 12.98 | / |
| 16 | 10.95 | 12.35 |
| 20 | 9.95 | / |
| 24 | 8.33 | 8.31 |

Figure 8:

The data was shown in Supporting Material S5.2

|  |  |  |  |
| --- | --- | --- | --- |
| **System** | **Current Density**  **(mAꞏcm-2)** | **Energy Consumption**  **(kJ/mol-CO2)** | **Reference** |
| BPMED | 50 | 394 | Eisaman |
| Electrolysis | 50 | 654 | Sharifian |
| Fuel cell | 20 | 537 | Shu |