***Supporting Information***

***I******n-Situ* Surface Protection for Enhancing Stability and Performance of Conversion-Type Cathodes**

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| **Table. S1** |
| **Parameters used in our calculation of energy densities and specific energies** |
| **Materials** | **Volumetric capacity (mAh.cm-3)** | **Density (g.cm-3)** | **Average discharge voltage (Graphite)** | **Average discharge voltage (Silicon)** | **Average discharge voltage (Lithium)** |
| **LFP** | 594 | 3.6 | 3.2 | 3.0 | 3.3 |
| **LCO** | 740 | 5.1 | 3.7 | 3.5 | 3.8 |
| **High Voltage LCO** | 944 | 5.1 | 3.85 | 3.65 | 3.95 |
| **NCA** | 890 | 4.45 | 3.6 | 3.4 | 3.7 |
| **NCM(111)** | 716 | 4.65 | 3.6 | 3.4 | 3.7 |
| **NCM(532)** | 790 | 4.65 | 3.6 | 3.4 | 3.7 |
| **NCM(811)** | 860 | 4.65 | 3.6 | 3.4 | 3.7 |
| **LiMnO2** | 595 | 4.25 | 3.2 | 3.0 | 3.3 |
| **LiMn2O4** | 510 | 4.25 | 3.8 | 3.7 | 4.0 |
| **Li2S** | 1937 | 1.66 | 2.0 | 1.8 | 2.1 |
| **Li2Se** | 1659 | 2.87 | 1.8 | 1.6 | 1.9 |
| **LiBr** | 1073 | 3.46 | 3.3 | 3.1 | 3.4 |
| **FeF2****/Fe-2LiF** | 2002 | 4.02 | 2.3 | 2.1 | 2.4 |
| **FeF3/Fe-3LiF** | 2196 | 3.65 | 2.4 | 2.2 | 2.5 |
| **CuF2/Cu-2LiF** | 2002 | 4.31 | 3.2 | 3.0 | 3.3 |
| **FeCl3/Fe-3LiCl** | 1172 | 2.67 | 2.5 | 2.3 | 2.6 |
| **Graphite** | 669 | 2.23 | - | - | - |
| **Lithiated Silicon** | 2196 | 0.63 | - | - | - |
| **Lithium** | 2062 | 0.534 | - | - | - |
| **O2/Li2O2** | 2699 | 2.31 | - | - | 2.65 |
| **O2/LiOH** | 1634 | 1.46 | - | - |  2.65 |