Claims

1. A battery system, the system comprising:

(a) a cell comprising a metal anode and a ~~cathode~~ current collector, the metal anode and the ~~cathode~~ current collector separated by a separator;

(b) a gas diffusion tank comprising an inlet for receiving oxygen in the gas diffusion tank, wherein the gas diffusion tank is connected to the current collector; and

(c) a connector between the current collector and the gas diffusion tank, the connector structured to allow an electrolyte to flow between the ~~cathode~~ current collector and the gas diffusion tank, the electrolyte comprising redox molecules for reducing the oxygen within the gas diffusion tank in a reduction reaction, reduced oxygen and metal ions in the electrolyte form metal-oxygen products in the gas diffusion tank, and the redox molecules flow back to the current collector after the reduction reaction,~~.~~

wherein the redox molecules comprise any molecule selected from the group consisting of a quinone derivative, an aromatic amine derivatives, a phenazine derivatives, a phenothiazine derivatives and quinoxaline.

~~2. The system according to claim 1, wherein the redox molecules may be any molecule selected from the group comprising: a quinone derivative, an aromatic amine derivatives, a phenazine derivatives, a phenothiazine derivatives and quinoxaline.~~

~~3.~~2. The system according to ~~any one of claims 1 or 2~~ claim 1, wherein ~~the~~ a concentration of the redox molecules in the electrolyte is about 5mM to 5M.

~~4.~~3. The system according to ~~any one of the preceding claims~~ claim 1, wherein the separator selectively allows ~~the~~ a passage of the metal ions only.

~~5.~~4. The system according to ~~any one of the preceding claims~~ claim 1, wherein the separator is any one selected from the group ~~comprising:~~ consisting of a lithiated Nafion or its composite membrane, and a lithium ion conductive ceramic membrane.

~~6.~~5. The system according to ~~any one of the preceding claims~~ claim 1, wherein ~~the metal in~~ the metal anode ~~is~~ comprises any metal selected from the group ~~comprising:~~ consisting of lithium, sodium, potassium, calcium, aluminium, zinc and magnesium.

~~7.~~6. The system according to claim ~~6~~ 5, wherein the metal anode comprises a lithium metal electrode, and wherein the lithium metal electrode is a vinylene carbonate pre-treated lithium foil.

~~8.~~7. The system according to claim ~~7~~ 6, wherein the lithium metal electrode further comprises a PVDF-Nafion composite membrane.

~~9.~~8. The system according to ~~any one of the preceding claims~~ claim 1, wherein the ~~cathode~~ current collector comprises a porous conducting matrix.

~~10.~~9. The system according to claim ~~9~~ 8, wherein the porous ~~substrate~~ conducting matrix is carbon felt.

~~11.~~10. The system according to ~~any one of the preceding claims~~ claim 1, further comprising a pump to pump the electrolyte ~~fluid~~ between the ~~cathode~~ current collector and the gas diffusion tank.

~~12. The system according to claim 11, wherein the pump is a peristaltic pump.~~

~~13.~~11. The system according to ~~any one of the preceding claims~~ claim 1, wherein ~~the gas in the gas diffusion tank is oxygen and the~~ a pressure of the oxygen in the gas diffusion tank is 1 atmosphere.

12. The system according to claim 1, wherein the battery system does not include a catalyst in the cell.