



## Novel Bifunctional Catalyst for Rechargeable Metal Air Battery/Fuel Cell

### Background

The rechargeable metal air battery, or metal air fuel cell, is an extremely promising electrochemical device for energy storage and has potential applications in electronics, hybrid electric vehicles, and stationary power generation. The performance of such a device is mainly limited by the slow kinetics of the oxygen reduction and evolution reactions on the cathode during battery discharge and charge. Consequently, the development of an active, stable, and affordable bifunctional catalyst is absolutely critical for the commercialization of this technology.

### Description of the invention

The technology concerns the development of a bifunctional catalyst which undertakes a core-corona structure\*, where nitrogen doped carbon materials constitutes the shell material and the oxides constitutes the core material (\*see figure a on top left). Candidates for the shell materials including nitrogen doped carbon fibres, nanotube, and particles. Candidates of core materials include a wide variety of oxides, such as oxides with perovskite, pyrochlore, spinel, and ruddlesen popper phase structures, for example,  $LaNiO_3$ ,  $La_{1-x}A_xFe_{1-y}Mn_yO_3$  (A=Sr or Ca),  $La_{0.6}Ca_{0.4}Co_{1-x}B_xO_3$  (B=Mn, Fe, Co, Ni or Cu),  $La_{n+1}Ni_nO_{3n+1}$ ,  $AB_2O_4$ , (A=Mg, Fe, Ni, Mn, or Zn, B=Al, Fe, Cr, or Mn),  $Pb_2M_{2-x}Pb_xO_7$  (M=Ru or Ir). Other oxides including transition metal oxides (manganese, iron, and nickel oxides) can also be used as core material.

### Advantages

In the proposed bifunctional catalyst, the core material would catalyze oxygen evolution reaction whereas the shell material would catalyze oxygen reduction reaction. The purpose of this bifunctional catalyst is to address the lack of stable and active bifunctional catalyst for oxygen reduction and evolution reactions for rechargeable metal air battery/fuel cell. The technology is currently being tested in a prototype zinc air fuel cell (see attached schematic) and promising results with respect to battery performance have been achieved despite the lack of optimization with respect to synthesis condition and electrode formulation.

### Potential applications

- Rechargeable metal air battery.
- Rechargeable metal air fuel cell.

### Reference

8810-7307

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### Patent status

Issued U.S., Chinese, Canadian and European patents

### Stage of development

Bifunctional catalyst successfully tested in prototype battery, ongoing research

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