Rechargeable lithium-oxygen batteries have recently attracted great attention due to their 5 ~ 10 times more energy density than current lithium-ion batteries 4, however, major challenges face before their commercialization. One of challenges is how to construct stable and high efficiently air electrode because oxygen electrochemistry intermediates attack the electrolyte and cathode, resulting in irreversible side reactions. Thus, it is essential to explore active oxygen electrocatalysts to promote the reversible formation/decomposition of Li2O2 during cycling.

A suitable electrocatalyst for Li-O2 batteries is expected to be sufficient electronic conductivity, stable towards nucleophilic attack by O2− and O22−, adequate activity to promote reversible formation/decomposition of Li2O2. In response, intensive research efforts have been made by applying metal oxides, metal nitrides and noble metal nanoparticles as electrocatalysts for O2 electrode. Among these materials, perovskite oxides have a high electronic/ionic conductivity. Several reports demonstrated the perovskite can be promising cathode materials for Li-O2 batteries. For example, Zhang et al synthesized perovskite-based porous La0.9Sr0.1MnO3 nanotubes to reduce over-potential and thus improve reversibility of the O2 electrode. The cell with La0.9Sr0.1MnO3 electrode can be cycled over 124 cycles over conventional carbon electrode. Mai et al also showed that a hierarchical mesoporous perovskite La0.5Sr0.5CoO2 nanowires can possess ultrahigh capacity over conventional carbon black electrode. Herein, a facile, effective, and scalable glucose combustion template method was used to synthesize porous La0.5Ca0.5CoO2.4Fe2O3 perovskite oxide. Its representative morphology is shown in Fig.1. It can be seen that the La0.5Ca0.5Co0.4Fe2O3 nanosheets are connected to form hollow-type pores, with diameters ranging from a few micrometers to several dozens of micrometers. The plentiful large pores of La0.5Ca0.5Co0.4Fe2O3 oxide will provide enough void volume for the deposition of discharge product, and thus result in a much enhanced discharge capacity. Meanwhile, these pore structure will also facilitate the mass transfer of lithium ions and oxygen.

The electrochemical activities of porous La0.5Ca0.5Co0.4Fe2O3 oxide were examined using the galvanostatic charge-discharge measurements in a Li-O2 battery cell with 1 M lithium trifluoromethanesulfonate/tetraethylene glycol dimethyl ether (LiCF3SO3/TEGDME) as the electrolyte. The preliminary cycle life of Li2O2 batteries is shown in Fig.2. The Li-O2 battery with La0.5Ca0.5Co0.4Fe2O3 perovskite oxide as electrocatalyst was stably cycled to 45 cycles, and appeared obvious polarization after sequent cycle process. Generally, the cycle life of Li2O2 batteries depends on the stability of electrolyte and electrode materials including the anode Li chip and cathode materials. Interestingly, we noticed that the lithium metal turned from metal chip to the white crystal completely after cycles test, which indicate that one of main reasons for performance fading on cycling is from the instability of anodic Li metal.