$La_{1.7}Sr_{0.3}NiO_4$ layered perovskite : a potential electrocatalyst for metal-air batteries

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Rechargeable metal-air batteries have received significant attention in recent years owing to an increasing need for the high-energy density storage of electric vehicles and portable powers. Metal-air batteries are predicted to have several times higher energy densities compared to current lithium-ion batteries. However, for the realization of metal-air batteries, many obstacles should be overcome. The main challenge facing the metal-air batteries is the limited electrical efficiency resulting from the sluggish kinetics and irreversibility of electrochemical oxygen reactions on an air cathode during charge and discharge. As a result, it is of great importance to develop highly active and reversible bi-functional cathode catalysts.

Various types of catalysts have been developed to reduce potential hysteresis and thus to improve the round-trip efficiency. The catalysts include carbon-supported noble metals and transition metal oxides based on Mn and Co [1]. Mixed transition metal oxides with a perovskite structure are also of interest due to their structural and chemical stability. Perovskite structures can be doped with a wide range of cations, which allows control of their catalytic properties. Perovskite oxides have long been considered a promising material capable of catalyzing oxygen reduction and evolution in metal-air batteries with aqueous electrolytes [2].

In the present work, we report another class of mixed oxide, La_2NiO_4-based phase with a layered perovskite structure. The La_2NiO_4-based catalysts are fabricated by Pechini method and are applied as a cathode catalyst for aqueous metal-air batteries such as hybrid lithium-air and zinc-air cells. The crystal structure of the La_2NiO_4-based catalysts is characterized and their catalytic activity is evaluated. The air cathode with La_2NiO_4-based catalyst shows a remarkably enhanced power density compared to the catalyst-free cathode in the zinc-air cell (Fig. 1). This report suggests the possibility that La_2NiO_4 with layered perovskite can be used as an efficient catalyst to improve the round-trip efficiency of metal-air batteries with aqueous electrolytes.

Reference

[1] S. Ida, A. K. Thapa, Y. Hidaka, Y. Okamoto, M. Matsuka, H. Hagiwara, T. Ishihara, *J. Power Sources* 203 (2012) 159.
[2] V. Neburchilov, H. Wang, J. J. Martin, W. Qu, *J. Power Sources* 195 (2010) 1271.

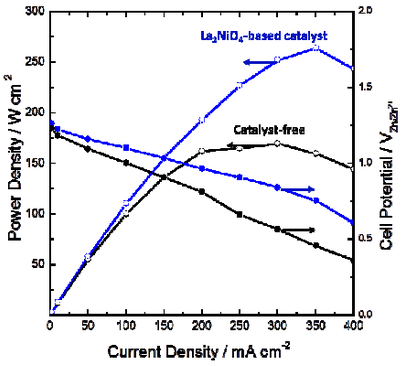

Fig. 1. Discharge cell potential and power density profiles of Zn-air cell at various discharge current densities of 2 - 400 mA cm^{-2}.