

ELECTROCHEMICAL CHARACTERIZATION OF MANGANESE OXIDES USED IN AIR ELECTRODES

Lanqun Mao⁺, Dun Zhang⁺⁺, Kenichi Nakatsu⁺⁺⁺,
Nobuharu Koshiba⁺⁺⁺, Tadashi Sotomura⁺
and Takeo Ohsaka⁺⁺

⁺ Battery Research & Development Center, Matsushita Electric Industrial Co., Ltd. 3-1-1, Yagumo-Nakamachi, Moriguchi, Osaka 570-8501, JAPAN

⁺⁺ Department of Electronic Chemistry, Interdisciplinary Graduate School of Science and Engineering, Tokyo Institute of Technology, 4259 Nagatsuta, Midori-ku, Yokohama 226-8502, JAPAN

⁺⁺⁺ Matsushita Battery Ind. Co. Ltd., Matsushita-cho 1-1, Moriguchi, Osaka 570-8511 JAPAN.

INTRODUCTION – Electrocatalytic reduction of oxygen (O_2) has drawn essential and extensive attention due to its importance in the development of air batteries [1]. Over last a few years, numerous works have been dedicated to designing innovative catalysts and various catalysts have been used to promote the decomposition of H_2O_2 or to effect a 4e- reduction of O_2 by either the peroxide pathway or a direct 4e- reduction on a modified electrode surface. MnO_2 , among metal oxides, has been widely used as cathode materials due to its availability, relatively low price, favorable charge density and electrode potential. However, a close overview of literatures [2] yielded few works on the electrochemical characterization of MnO_2 as well as other kinds of $MnOx$ such as Mn_2O_3 , Mn_3O_4 , Mn_5O_8 and $MnOOH$ in O_2 reduction in spite of their potential application as efficient catalysts in battery industry. Our attention here is focused on the elucidation of electrochemical behavior of $MnOx$ in O_2 reduction at gold (Au) electrode in 0.10 M KOH solution.

EXPERIMENTAL – 1.2 mg $MnOx$ powders were suspended thoroughly by sonication in 250 μ l of 0.05 % Nafion ethanol solution. Ten μ l of the resultant suspension was applied on Au electrodes with a micro-syringe and air-dried for 30 min to obtain Nafion/ $MnOx$ -modified Au electrodes.

RESULTS AND DISCUSSION – As can be seen from Figs. 1 and 2, the $MnOx$ -modification of Au electrodes enables a clear increase in the reduction current of O_2 to hydrogen peroxide as well as an obvious decrease in the peak current of hydrogen peroxide to OH. It can be also found that only MnO_2 , among all kinds of $MnOx$, is electroactive and only its modification results in a great enhancement in the first reduction peak current compared with that at Nafion-modified Au electrodes. This suggests that the catalytic reduction of O_2 with MnO_2 and other kinds of $MnOx$ is based on different processes, in which the catalytic process of MnO_2

involves a redox-mediation for 2e reduction of O_2 as well as a catalytic decomposition of H_2O_2 whilst other kinds of $MnOx$ only show the latter one.

REFERENCES

1. H. H. Yang and R. L. McCreery, *J. Electrochem. Soc.*, **147**, 3420-3428 (2000).
2. K. Kinoshita, *Electrochemical Oxygen Technology*, p. 283-285. John Wiley & Sons Inc., 1992.

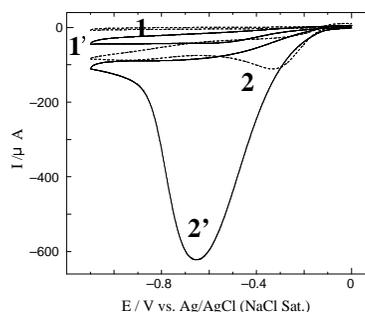


Fig. 1 CVs at (....) Nafion and (—) Nafion/ MnO_2 -modified Au electrode (4 mm diameter) in (1 and 1') Ar-saturated and (2 and 2') O_2 -saturated 0.10 M KOH solution. Scan rate: 100 mVs^{-1} .

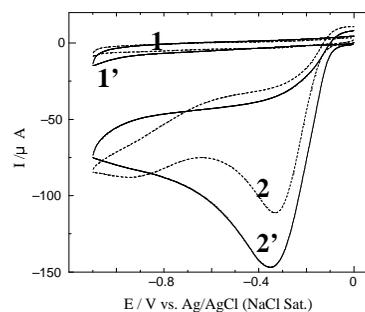


Fig. 2 CVs at (....) Nafion and (—) Nafion/ Mn_3O_4 -modified Au electrode in (1 and 1') Ar-saturated and (2 and 2') O_2 -saturated 0.10 M KOH solution. Scan rate: 100 mVs^{-1} .