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The superconducting oxides, yttrium barium copper oxide (A) and neodymium copper oxide (B) were fabricated into cathodes for lithium nonaqueous batteries. The cathode limited cells had electrolytes of 1M $LiClO_4$ or $LiAsF_6$ in propylene carbonate or 2-methyl-tetrahydrofuran and were hermetically sealed in stainless steel case-positive cans. The initial open circuit potentials were in the range of 3.0-3.5 volts for all cell types. The potentials of both type A and B cells with oxides prepared in an atmosphere of O_2 were about 200 mV greater than those for cathodes that have been prepared in an N_2 atmosphere. Cycle and capacity test results are presented. Keywords)

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PERFORMANCE OF SUPERCONDUCTIVE OXIDES AS CATHODES FOR LITHIUM RECHARGEABLE BATTERIES

B.B. Owens, M.Z.A. Munshi, P.S.S. Prasad, W.H. Smyrl
W. Kinzy Jones*, J.B. Schlenoff** and H.F. Wu**
University of Minnesota, Minneapolis, MN-55455, U.S.A

The superconducting oxides, yttrium barium copper oxide (A) and neodymium copper oxide (B) were fabricated into cathodes for lithium nonaqueous batteries. The cathode limited cells had electrolytes of 1M $LiClO_4$ or $LiAsF_6$ in propylene carbonate or 2-methyl-tetrahydrofuran and were hermetically sealed in stainless steel case-positive cans. The initial open circuit potentials were in the range of 3.0 - 3.5 volts for all cell types. The potentials of both type A and B cells with oxides prepared in an atmosphere of O_2 were about 200 mV greater than those for cathodes that have been prepared in a N_2 atmosphere. Cycle and capacity test results are presented.

1. INTRODUCTION

The possibility of utilizing superconducting oxides as the electropositive electrode in nonaqueous lithium batteries was recently described by Jones[1] who reported the discharge of a primary cell

$$Li/1M\ LiClO_4,\ 1,\ 3\ dioxolane/YBa_2Cu_3O_7 \qquad (I)$$

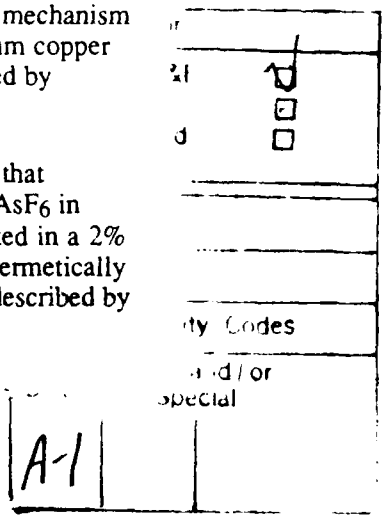
Jones reported the apparent insertion of 0.87 Li^+ into the cathode at 25°C, with no effect on the superconductive transition temperature.

2. EXPERIMENTAL

We have further investigated these reactions for cell systems that may be rechargeable in order to assess the reversibility of the ion insertion, assuming that the discharge mechanism is not a decomposition type of reaction. The superconducting oxides, yttrium barium copper oxide ($YBa_2Cu_3O_7$) and neodymium copper oxide ($Nd_2CuO_{4-x}F_x$) were synthesized by procedures described by Jones[1] and James[2], respectively.

These oxides were fabricated into cathodes for lithium nonaqueous batteries that contained a large excess of lithium. The cells had electrolytes of 1M $LiClO_4$ or $LiAsF_6$ in 2-methyltetrahydrofuran (THF), or 1, 3 dioxolane (DOL). The cells were fabricated in a 2% relative humidity dry room under controlled environmental conditions and were hermetically sealed in stainless steel case-positive cans. The design was essentially the same as described by

* Florida International University, Miami, FL 33199
**Florida State University, Tallahasee, FL, 32306



Jones[1]. In addition to cell type I, the following cells were also investigated:

$$Li/1M\ LiAsF_6,\ THF/YBa_2Cu_3O_7 \qquad (II)$$

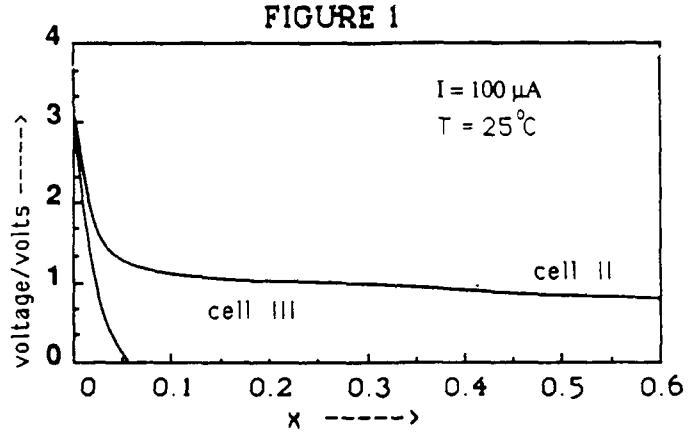
$$Li/1M\ LiAsF_6,\ THF/Nd_2CuO_{4-x}F_x \qquad (III)$$

3. RESULTS

The initial open circuit potentials were in the range of 3-3.5 volts for all cell types. The potentials of those cells with oxides prepared in an atmosphere of O_2 were about 200 mV greater than those for cathodes that had been prepared in a N_2 atmosphere.

Cells II and III were discharged under identical conditions, at a rate of 100 microamps. Up to 0.75 lithium ions inserted into the $YBa_2Cu_3O_7$, but only 0.03 lithium ions inserted into the $Nd_2CuO_{4x}F_x$, as shown in Figure 1. The cell II was cycled at x = 0.04 and demonstrated reversible behavior. Further tests are in progress to identify the nature of the discharge products for these cell systems.

FIGURE 1



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2. James et al. Nature, 338, 240 (1989).