use any of these diamines or any combination of them in proportions chosen to impart desired properties to the finished product. Alternatively or in addition, one could similarly vary the functionality of the alkoxysilane to obtain desired properties. The variety of available alkoxysilanes and diamines thus affords flexibility to optimize the organic/inorganic polymer for a given application.

This work was done by James D. Kinder and Mary Ann B. Meador of Glenn Research Center. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-17592-1.

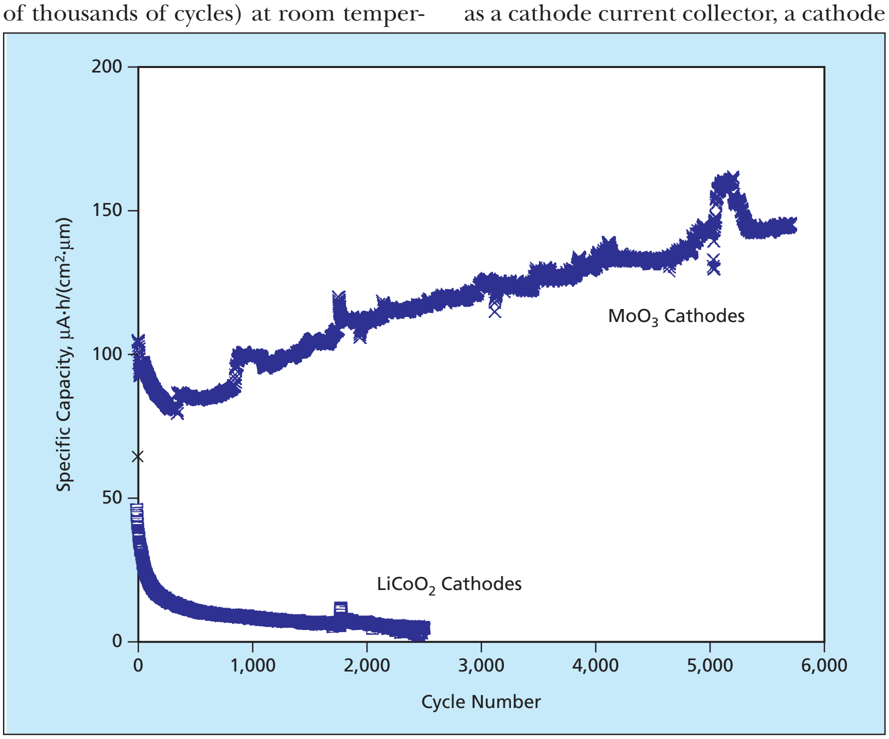
MoO_3 Cathodes for High-Temperature Lithium Thin-Film Cells

Cycle lives of these cathodes exceed those of $LiCoO_2$ and $LiMn_2O_4$ cathodes.

NASA's Jet Propulsion Laboratory, Pasadena, California

MoO_3 has shown promise as a cathode material that can extend the upper limit of operating temperature of rechargeable lithium thin-film electrochemical cells. Cells of this type are undergoing development for use as energy sources in cellular telephones, wireless medical sensors, and other, similarly sized portable electronic products. The $LiCoO_2$ and $LiMn_2O_4$ cathodes heretofore used in these cells exhibit outstanding cycle lives (of the order of hundreds of thousands of cycles) at room temperature, but operation at higher temperatures reduces their cycle lives substantially: for example, at a temperature of 150 °C, cells containing $LiCoO_2$ cathodes lose half their capacities in 100 charge/discharge cycles.

The superiority of MoO_3 as a cathode material was demonstrated in experiments on lithium thin-film cells fabricated on glass slides. Each cell included a layer of Ti (for adhesion to the glass slide), a patterned layer of Pt that served as a cathode current collector, a cathode layer of MoO_3, a solid electrolyte layer of $Li_{3.3}PO_{3.8}N_{0.22}$ ("LiPON"), and an anode layer of Li. All the layers were deposited by magnetron sputtering except for the Li layer, which was deposited by thermal evaporation.



The **Specific Capacities and Cycle Lives** of cells containing $LiCoO_2$ and MoO_3 cathodes at a temperature of 150 °C were measured in charge/discharge cycling at a current density of 0.7 mA/cm^2.

These cells, along with similar ones containing $LiCoO_2$ cathodes, were subjected to several tests, including measurements of specific capacity in charge/discharge cycling at a temperature of 150 °C. The results of these measurements, plotted in the figure, showed that whereas specific capacity of the cells containing $LiCoO_2$ cathodes faded to about half its initial value after only 100 cycles, the specific capacity of the cells containing the MoO_3 cathodes faded only slightly during the first few hundred cycles and thereafter not only recovered to its initial value but continued to increase up to at least 5,500 cycles.

This work was done by William West and Jay Whitacre of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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