Recent publications

1 G. Mamantov, V. E. Norvell and L. Klatt, Spectroelectrochemistry in melts: applications to molten chloroaluminates, *Ext. Abstr. No. 357, Volume 78-2, Fall Meeting Electrochem. Soc., Pittsburgh, PA, October 15 - 20, 1978.*
2 R. Huglen, F. W. Poulsen, G. Mamantov, R. Marassi and G. M. Begun, Raman spectral studies of elemental sulfur in Al_2Cl_6 and chloroaluminate melts, *Inorg. Nucl. Chem. Lett.*, *14* (1978) 167.
3 R. Marassi, G. Mamantov, M. Matsunaga, S. E. Springer and J. P. Wiaux, Electrooxidation of sulfur in molten $AlCl_3$–NaCl (63 - 37 mole%), *J. Electrochem. Soc.*, *126* (1979) 231.
4 G. Mamantov, R. Marassi, F. W. Poulsen, S. E. Springer, J. P. Wiaux, R. Huglen and N. R. Smyrl, SCl_3AlCl_4: Improved synthesis and characterization, *J. Inorg. Nucl. Chem.*, *41* (1979) 260.

PERFORMANCE CHARACTERIZATION OF A SOLID STATE STORAGE BATTERY SYSTEM

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Totally solid state lithium batteries have been produced for several years for extremely long-life, low rate, ambient temperature applications. Since no liquid is present, there is no leakage, no self-discharge, and no corrosion. Also, individual cell containers are not needed, since the solid cells may be stacked one on top of the other. This frees valuable space for the active components and results in increased packaging efficiency. No sintering of the $LiI(Al_2O_3)$ solid electrolyte is necessary, since it can be densified simply by pressing. It was recently discovered that this electrolyte can be made highly conductive and stable towards lithium at 300 °C, opening up the possibility of making high rate, totally solid, rechargeable cells of the type Li intermetallic/LiI (Al_2O_3)/solid cathode. Preliminary tests confirmed that the development of such cells was feasible, and calculations showed that cost-competitive batteries having energy densities and sustained power densities of 200 W h/kg and 70 W/kg, respectively, could ultimately be developed. The intent of the present program is to define and investigate as far as possible the scientific and engineering problems that will be encountered during such development and to increase cell performance to the point that batteries can be made.

The program thus far has concentrated on making small (0.6 in. dia., 100 mA h) cells containing various cathode compositions and cycling them between 1 V and 3 V at 5 mA/cm^2 and 300 °C. Substantial progress has been made in that over 50 discharge/charge cycles have been realized before the cathode utilization drops below 20%. Coulombic efficiency is close to 100%.

Studies have also been carried out on the $LiI(Al_2O_3)$ solid electrolyte. These have been successful in that the factors contributing to the high conductivity and stability of the electrolyte are now better understood. Material of the quality necessary to meet the requirements of the cycling experiments carried out thus far can be made routinely.

Preliminary efforts to make larger diameter cells by the usual punch-and-die pressing techniques have also been carried out. Some problems with weakly bonded interfaces have been considerably alleviated by annealing.

The objectives during the remainder of the present program include: (1) the continued evaluation of the cycling characteristics of different cathode mixes; (2) the testing of the most promising cathode mix in a larger area cell; (3) the preliminary testing of cells having higher stoichiometric capacities per unit area; (4) the design, building, and testing of reusable, hermetically sealed cans for cell cycling.

We have found no problems thus far that would seem to be intractable or to prevent the full development of a high rate, solid state system. The problems that should be addressed in the follow-on programs are both scientific and engineering in nature, that is, they should involve both basic studies and the investigation of scale-up problems. They include: (1) a study of the ionic and electronic conductivity of cathode materials after partial discharge and after repeated cycling; (2) an investigation of the magnitude of the interface impedances after partial discharge and after repeated cycling; (3) the development of fabrication methods to make improved higher area and higher capacity cells; (4) an investigation of problems that may be encountered when several cells are stacked in series or parallel; (5) the continued development of appropriate testing equipment (hermetic cell and battery containers, etc.); (6) a comprehensive scientific and engineering study of the $LiI(Al_2O_3)$ solid electrolyte.

Recent publications

1 C. C. Liang, A. V. Joshi and N. E. Hamilton, Solid state storage batteries, *J. Appl. Electrochem.*, *8* (1978) 445.

LOW TEMPERATURE ALKALI METAL–SULFUR BATTERIES

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The aim of this program is the development of a practical ambient temperature Li/S secondary battery. The cell has a liquid electrolyte containing the dissolved cathode as Li_2S_n. Due to the formation of a protective passiva-