Battery electrode studies

The behavior of electrodes in aqueous and molten salt electrolytes will be studied and means to improve their performance and lifetime investigated.

Recent publications

1 P. Fedkiw and J. Newman, Low Peclet number behavior of the transfer rate in packed beds, *Chem. Eng. Sci., 33* (1978) 1043.
2 J. A. Trainham and J. Newman, The effect of electrode placement and finite matrix conductivity on the performance of flow-through porous electrodes, *J. Electrochem. Soc., 125* (1978) 58.
3 M. Jaksic and C. W. Tobias, Effects of hydrodynamic flow on the development of the morphology of electrode-deposited zinc, *Ext. Abstr. 29th Meeting Int. Soc. Electrochemistry, Aug. 28 - Sept. 2, 1978, Part II,* p. 1164.
4 R. Atanasoski, H. Law and C. W. Tobias, Electrochemical reduction of potassium chloride in propylene carbonate electrolyte with aluminum anodes, *LBL-8505, December 1978.*
5 C. G. Craig, Ellipsometry of anodic film growth, *LBL-8082 (Ph.D. thesis).*
6 R. D. Peters, Ellipsometry of surface layers on lead and lithium, *LBL-8375 (M.S. thesis).*
7 P. Fedkiw and J. Newman, Entrance region (Lévêque-like) mass transfer coefficients in packed bed reactors, *LBL-8216, September, 1978.*
8 R. Pollard and J. Newman, Transport equations for a mixture of two binary molten salts in a porous electrode, *J. Electrochem. Soc.*, in press *(LBL-8284, October 1978).*
9 R. Pollard and J. Newman, Transient behavior of porous electrodes with high exchange current densities, *Electrochim. Acta,* in press *(LBL-8317, October 1978).*
10 P. S. Fedkiw, Mass-transfer controlled reactions in packed beds at low Reynolds numbers, *LBL-8509, December 1978 (Ph.D. thesis).*
11 J. W. Evans, Y. Zundelevich, E. Tarapore and D. Sharma, Magnetic fields, current densities, melt velocities and current efficiencies in Hall–Héroult cells — computations and comparison with measurements, *LBL-8519.*
12 J. A. Trainham and J. Newman, A comparison between flow-through and flow-by porous electrodes for redox energy storage, *LBL-9331, June 1979.*
13 J. A. Trainham, Flow-through porous electrodes, *LBL-9565, August 1979 (Ph.D. thesis).*
14 J. R. Selman and C. W. Tobias, Mass-transfer measurements by the limiting-current technique, *Adv. Chem. Eng., 10* (1978) 211.
15 F. R. McLarnon, R. H. Muller and C. W. Tobias, Interferometric study of forced convection mass transfer boundary layers in laminar channel flow, *Ind. Eng. Chem. Fundam., 18* (1979) 97.
16 P. Fedkiw and J. Newman, Numerical calculations for the asymptotic, diffusion dominated mass-transfer coefficient in packed bed reactors, *Chem. Eng. Sci., 33* (1978) 1563.

DEVELOPMENT OF EVALUATION TECHNIQUES FOR ELECTROCHEMICAL ENERGY STORAGE SYSTEMS

Exxon Research & Engineering Co., Box 8, Linden, NJ 07036 (U.S.A.)

The two primary objectives of this program are, first, the development of a quantitative rationale for the comparison and evaluation of promising advanced battery technologies. This methodology considers both the traditional measures of battery performance (specific energy, costs, and cycle life) and the equally important practical evaluation criteria (probability of technical success, operating and maintenance parameters, and safety/environmental impact). The second objective is the development of procedures for generating battery test programs normalized to specific technologies and electric vehicle mission specifications.

To accomplish these objectives vehicle design and cost models were used to produce optimized vehicle designs and estimates of the total cost of vehicle ownership. Emphasis was placed on subcompact vehicles with ranges between 60 and 160 km. Vehicles with ICE equivalent power capability were of particular interest in the development of market impact estimates. Market impact and potential petroleum savings were estimated by comparison of vehicle ownership costs with equivalently sized petroleum fueled vehicles.

A single figure of merit for each candidate battery system was developed by combining estimates for petroleum savings with a ranking procedure developed to compare each battery's potential for technical success and suitability for EV use with existing lead–acid batteries. The combined figure of merit, reflecting both the technical desirability and the practical suitability of each battery system, provides a concise planning and decision making tool.

While the specific objectives of this program are limited to the development of the evaluation methodology rather than the presentation of actual battery system comparisons, several conclusions were reached as a result of trial runs using available estimates of battery performance:

(1) Battery systems with energy densities as low as 40 W h/kg have large market potential if they can be manufactured at low cost.

(2) High first cost suggests that practical electric vehicles will be limited to urban driving ranges of less than 200 km.

(3) Unless battery costs can be reduced substantially there is little additional incentive for energy densities above 120 W h/kg.

(4) Cost optimized EV's will have ranges in the area of 80 - 120 km.

(5) The comparative utility of batteries is more sensitive to their probability of technical success and practicality for EV use than it is to differences between anticipated energy density and cost levels.

OXYGEN ELECTROCATALYST PREPARATION AND CHARACTERIZATION

Case Laboratories for Electrochemical Studies, Cleveland, OH 44106 (U.S.A.)

Case Western Reserve University is carrying out Tasks 1 - 4 in close cooperation with the Diamond Shamrock Corporation as the prime contractor.