within a wide range of potential, and serviceability of lithium accumulators over long periods of cycling.

Two types of polymer-containing electrolytes were investigated.

(a) liquid non-aqueous electrolyte with up to 5% of polymer components, these being n-organosiloxane or n-silocrownester derivatives of poly-2-methyl-5-vinylpyridinium halides

(b) solid or gelatinous polymer electrolytes based on chlorinated polyvinylchloride.

The impedance characteristics of Li–Li, Li/MnO_2, $Li/LiMn_2O_4$, Li/FeS_2 systems have been studied. Mechanisms of the interaction of electrolyte components with electrode materials are proposed. X-ray diffraction and other supporting data on the polymers and solid electrolytes have been obtained.

In the case of type (a) electrolytes, it appears that the nature of functional groups present in the branches of polymer, the number of ionic groups present and the synthesis prehistory determine the impedance and characteristics of the systems.

The modification of the structure and composition of polyviny chloride by additional chlorination (chlorine content Increased from 56.7% to 60–72%) gives a decrease in the degree crystallinity of the system, and increases its elasticity. Accordingly, the properties of polymer electrolyte are improved significantly: system conductivity increases, the resistance of the passivating film on the lithium surface decreases and this means that the technological problems of fabrication lithium accumulators are solved efficiently.

The test results from samples of lithium accumulators with polymer electrolytes, containing either the 3.0 V Li/MnO_2 4.0 V $Li/LiMn_2O_4$ system will be displayed.

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PII: S0378-7753(99)00089-0

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The practical, popular, battery powered car—the driving operational requirement for battery technology

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1. The problem

How many business executives would choose a battery powered, plastic bodied bubble car as the company car in preference to a 3-litre BMW? The public image of the electric car is poor, irrespective of environmental concerns. Like bicycling or organic crops, at best it is good for other people.

2. Present limitations

To overcome this image problem it would be easier for the marketeers if an electric car could replicate or surpass the performance of an internal combustion-engined car in all respects, rather than having to sell the ‘green image’ or rely on environmental legislation to force a change. So far, battery and electric automotive technologies in production has not achieved this. The Bluebird Electric LSR team aims to achieve a 300 mph speed record with an electric car. During the course of this project, it has been appropriate to estimate the degree of progress required in these technologies before electric cars can eclipse the i.c. engine.

3. The goal

The Operational Requirement is for a combination of batteries, motors and drive train to match or stirpass the i.c. power plant, fuel and transmission systems in all aspects—mass efficiency, power, noise, tractability, convenience-particularly of refuelling, service life, overall emission cycle and cost of ownership,

Comparison is made here between available i.c. automotive power systems and current and projected electric motor and battery technologies. A parametric comparison determines the performance envelope required of each—which is the Operational Requirement or O. R.

4. The O.R.

Comparison is made between available i.c. power systems and electric technology. A typical saloon car power train achieves 1.4 to 2.0 kW h kg^{-1}. The in-hub, brushless d.c. motors and gearbox technology used in Bluebird achieve 8–10 kW kg^{-1}, necessitating 1.8–2.1 kW h kg^{-1} batteries for an electric car to match i.c. performance. This is still highly demanding, even for fuel cells. Structural refinement to reduce this requirement would be available to i. c. also and cannot redress the balance entirely.

It appears, therefore that wholly new battery technologies are needed rather than incremental improvements to available systems. Spin-offs outside of the automotive field would include a 24-hour laptop computer life between battery charges, a week or more for a mobile phone, or ten cassettes in a camcorder—even portable microwave ovens. The market benefits for whoever introduces these technologies will be considerable.

PII: S0378-7753(99)00090-7