

produces a greater drop in the electronic component than does lithium chloride. Nevertheless, even with sufficiently large dilutions the electron transfer remains considerable.

This experimental fact shows great promise for the use of CuCl–CuCl<sub>2</sub> melt as a cathodic material in high-temperature batteries employing Li/CuCl–CuCl<sub>2</sub> and Na/CuCl–CuCl<sub>2</sub> electrochemical systems.

We used the Nernst-Einstein equation to calculate the effective values of electron diffusion coefficients. The latter greatly exceed the values of Li<sup>+</sup> and Na<sup>+</sup> diffusion coefficients, usual for chloride melts, with dilution they drop in value and gradually become equal to zero.

We examined various mechanisms of transfer of electrons from cation Cu<sup>+</sup> to Cu<sup>2+</sup> in the investigated systems. It was assumed that the contribution to the electron transfer is made not by the direct interaction between cations Cu<sup>+</sup> and Cu<sup>2+</sup> but by their interaction through the medium of a Cl<sup>–</sup> anion.

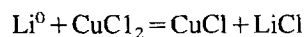
## P29

### High temperature lithium storage battery with an electron-conducting CuCl–CuCl<sub>2</sub> melt as cathodic material

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When a power source based on Li/CuCl<sub>2</sub> discharges, there takes place an accumulation of lithium chloride in the cathodic half-element in accordance with the current-producing reaction:



During recharging a reverse process occurs. In this investigation we studied cathodic and anodic polarization at the glassy carbon electrode in the CuCl–CuCl<sub>2</sub>–LiCl melt as a function of temperature and lithium chloride concentration at atmospheric pressure in chlorine. Measurements have shown that cathodic polarization in melts having considerable copper chloride concentrations is practically equal to zero over the current density range of 0 to 10 A cm<sup>–2</sup> while the anodic polarization is two orders of magnitude lower than that measured for purely ionic melts. Such values of polarization are explained by the presence of electronic conductivity together with ionic. We have also established that polarization measured relative to the reference electrode, filled with a purely ionic melt, has substantially higher values than the same polarization measured relative to the glassy carbon electrode immersed directly into the CuCl–CuCl<sub>2</sub>–LiCl melt. In this work we have shown that Wagner's notions of emf of electrochemical cells having ionic-electronic conductivity, developed by him for solid electrolytes, are applicable to melts studied by us. Wagner's equations were used to calculate

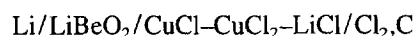
electron transference numbers. Within measurement error limits they coincided with measured values as regards non-correspondence of current output during electrolysis of these melts according to Faraday law. The most interesting experimental fact is that even with very high degrees of dilution of the CuCl–CuCl<sub>2</sub>–LiCl mixture with lithium chloride (up to 70 mol.%) the electron transference number has a significant value (0.25 to 0.30).

In comparison with the sodium-sulphur battery the one employing a Li/CuCl<sub>2</sub> system has the following advantages:

- about 1.2 V higher;
- no cathodic polarization;
- low electrolyte resistance in each half-cell because of electron transfer;
- possibility of reducing polarization at the Li/solid electrolyte and solid electrolyte/melt interfaces as a result of temperature increase.

A drawback of the Li/CuCl<sub>2</sub> system is that redox-potential E<sub>Cu<sup>2+</sup>/Cu<sup>+</sup></sub> drops sharply as the CuCl<sub>2</sub> changes into CuCl. However, taking into account the above-mentioned advantages, the specific power of a high-temperature battery using Li/CuCl<sub>2</sub> can be 4–5 times as great as that of the sodium-sulphur battery.

On the basis of results obtained, a laboratory model of the storage battery using two types of electrochemical cells was constructed:



Ten charge-discharge cycles were carried out. No deterioration of characteristics was noticed. The polarization of the cathodic half-element was zero. The test results give hope that a storage battery using CuCl–CuCl<sub>2</sub> melt will be developed with the following specific characteristics: energy density — 150 Wh kg<sup>–1</sup>; power density — 800 W kg<sup>–1</sup>.

## P30

### Investigation aimed at development of a high-temperature lithium/air storage battery

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Power sources for battery-driven vehicles of the future must have high specific characteristics: specific energy not less than 200 Wh kg<sup>–1</sup>, peak specific power not less than 700 W kg<sup>–1</sup>.

Traditional storage batteries and those being developed for these purposes, except for sources having polymer electrolyte, will not be able to give a specific energy higher than 200 Wh kg<sup>–1</sup>. One of the main reasons is the low theoretical specific energy, as a rule less than one kWh kg<sup>–1</sup>, character-