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Development and Increase in the Reliability of the Small Storage Batteries, Utilized for the Nourishment of the Mobile Radio-Technical Devices

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I. Introduction

The development of mobile connection, small flight vehicles and other movable radio-technical systems required new studies on the development of the small, energy-consuming and reliable power sources.

Movable radio-technical devices and small flight vehicles require the reliable and small power sources; therefore many firms and producers actively work in this direction. Reliability and safety of such sources has special importance. Development and production of the storage batteries of group is the especially promising trend of such Li studies. This group includes lithium-ionic storage batteries. In these storage batteries were used lithium cobalt and lithium manganese electrodes, and also electrodes from the iron phosphate of lithium. In addition to this were developed nickel-metal hydride storage batteries also characterizing by high paramerami. Studies in this direction made it possible to create storage batteries with the large energy content, by small overall sizes and safe with their use.

II. Construction and the Fundamental Characteristics of the Small Storage Batteries Li of the Group

The high reactive activity of lithium is one of the essential obstacles on the way of developing the lithium storage batteries. The first models of lithium storage batteries were completely inflammable and dangerously explosive. Were not rare the cases, when they exploded during operation in the cell phones, inflicting injuries on their users. In addition to this, in such storage batteries were limited the cycles of precharge, average cyclability of was near 50 cycles. Storage batteries went out of order because of the fact that the dendrites of lithium germinated to the electrode with the opposite sign, which led to a short circuit inside the battery and its heating. In this case lithium reacted violently with the organic electrolyte, which sufficiently frequently led to the explosion.

In 1992 the year the corporation Sony undertook the attempt to develop new storage batteries on the basis of lithium. In this case metallic lithium was substituted with safer ionic form. For the purpose of the decrease of explosion hazard such storage batteries were equipped with the system the control of the regimes of charge and discharge, that it made it possible to sharply decrease the risk of appearance in the storage battery of metallic lithium. In this case as the positive electrode cobaltate of lithium was used, and negative electrode was executed on the basis of carbon. In this case was used the coke - the material, obtained with the heat the treatment of bituminous coal. In these storage batteries as the electrolyte the hexafluorinephosphide of lithium, dissolved in the organic solvent was used [1]. Other developers instead of the coke used graphite powder of different granularity. However, success was achieved not immediately, and it was necessary to conduct the large volume of studies on the selection of the correct structure of graphite powder.

Since the firm Sony patented lithiumcobalt positive electrode, other developers order study on the development the diverse variants on the base of lithiummanganese, lithiumironphosphate and many others chemical components [2].

In Fig. 1 the schematic of crystal lattice of lithium-cobalt electrode is shown.

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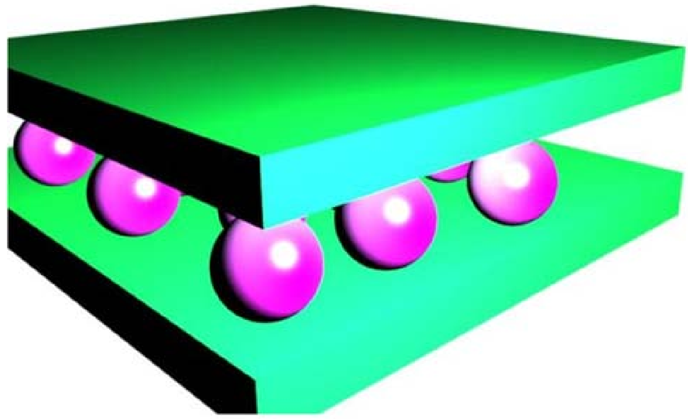

Fig. 1: Schematic of crystal lattice of the lithium-cobalt electrode

Whole the row of new electrodes they showed itself from the best side. At present the widest use obtained lithium-manganese, lithium-cobalt, lithium-ironphosphate and lithium-ionic storage batteries.

Stability of lithium-cobalt crystal lattice it is low. With this is connected the circumstance that the lithiumcobalt storage batteries do not allow large discharge currents, which narrows the framework of their application.

In Fig. 2 crystal lattice of the lithium-manganese electrode is shown.

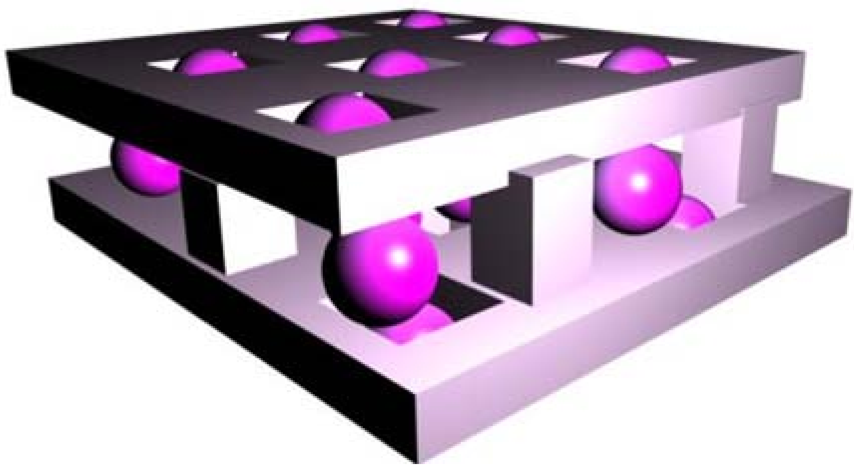

Fig. 2: Crystal lattice of the lithium-manganese electrode

On the lithium-manganese electrode the three-dimensional arrangement of lithium ions occurs. This circumstance gives the possibility to ensure the high currents of discharge and a good stability of electrode during this discharge.

Lithium-ironphosphate positive electrodes showed high operating characteristics. This connected with the fact that they have steadier crystal lattice, capable of passing lithium ions. Unfortunately, this circumstance leads to reduction in the ion mobility of lithium; therefore such electrodes are used relatively recently. Their widespread introduction began after it was possible to create the electrodes, on which the particles of the lithium-ironphosphate they had with size into hundreds of nanometers (particle size one hundred times less than in 3D lithiummanganese storage batteries). This led to the fact that their effective area increased almost by four orders, which radically improved the characteristics of lithium ironphosphate storage batteries.

In Fig. 3. The schematic of crystal lattice of ironphosphate of lithium is depicted.

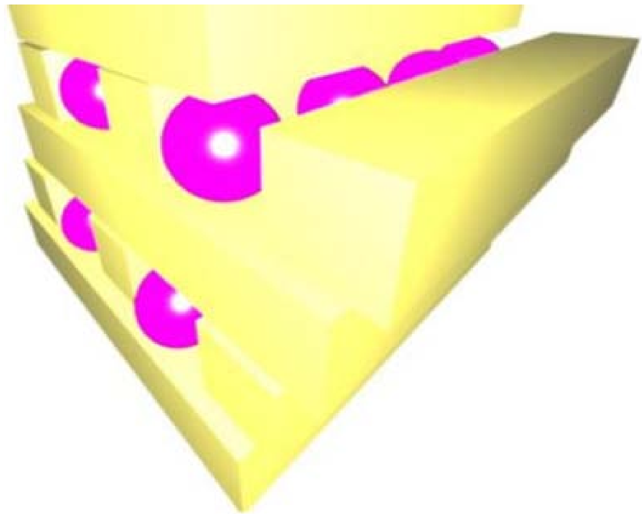

Fig. 3: Schematic of crystal lattice of ironphosphate of lithium

The positive qualities of lithiumironphosphate storage batteries led to their wide application in the systems, which require the high starting currents (for example, as the starter batteries in the automobiles)

It should be noted that not only the use of promising materials for preparing the negative electrode led to an improvement in the quality of storage batteries. Played the decisive role the use of the electrolytes, when the polymeric materials, which use the gelatinous lithium- conducting filler, were used as the electrolyte. Storage batteries with such electrolytes became basis for preparing their miniature versions.

Further improvement made it possible to create solid electrolyte. In this electrolyte lithium ions become conducting in connection with by the exchange of ions inside the matrix of electrolyte.

Developments in the field of polymeric electrolytes made possible to create the solid electrolyte, in which lithium ions become conducting in connection with by the exchange of ions inside the matrix of electrolyte. This electrolyte made it possible to restore the finished storage batteries with the electrodes from metallic lithium.

In the solid electrolyte is hindered the formation of the dendrites of lithium with the cycling, which excluded the possibility of fire and explosion of lithium storage batteries.

The problem of the use of lithium- polymeric storage batteries consists in the fact that their operating temperature is higher than 40 the degree Celsiuss. This connected with the fact that the ionic conductivity of solid electrolyte at room temperature is very small. This circumstance requires preheating storage battery, which substantially limits its applicability.

Today still remain the problems of negative electrode in the lithiumionic storage battery. Therefore developments on the base of titanate of lithium appeared. Combination of these electrodes with the positive electrodes on the basis of lithiumironphosphate made possible sharply to increase the lifetime and level of safety of lithium-ionic storage batteries.

NiMH batteries storage batteries is used as the second chemical-battery power supplies [3].

Studies on the creation of NiMH- storage batteries were begun still 1970 and were completed by the creation of storage batteries with the high energy density. In this case the new metal-hydride connections were used [4].

Such batteries have a larger capacity (about 20%) than nickel-cadmium batteries with the same dimensions. The disadvantage of such batteries is that they allow only 200 - 300 cycles.Self-discharge in these storage batteries also approximately in 1, 5-2 time is higher than in nickel-cadmium storage batteries.

The common form of NiMH- storage batteries is shown in Fig. 4.

Fig. 4: The common form of the NiMH- storage batteries

III. Conclusion

Only quick overview of the existing methods of improving the storage batteries is carried out, since to short article it is not possible to illuminate this capacious theme as chemistry of the second chemical-battery power supplies, based on lithium. One should hope that even this survey of the existing solutions will help the reader better to understand processes taking place in the systems examined and not to be tangled in the advertising communications. The rate of new developments now by such, that each half a year appear the new developments of lithiumionic storage batteries, and only time and test can give answers for questions of the correspondence of the operating characteristics, declared by producers, to real indices. In the article given the description of construction are given the fundamental characteristics of the small storage batteries Li of group. The fundamental characteristics of the nickel metal hydride storage batteries are given Ni-MH. Development and application of such storage batteries significantly increased the reliability of small mobile radio sets, in particular, cell phones.

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