USE EXHAUSTED LITHIUM BATTERIES OF SYSTEM $Li/LiBF_4$-$(BL/(CF_x)_n$ FOR RECEPTION ELECTROLYTES

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Last decades lithium batteries in the market of sources of a current hold leading positions on a sales volume and interest on the part of consumers. High technical parameters, durability of operation, an opportunity of application at the lowered temperatures put these batteries in a number of the elements which are not having alternatives in the near future. However, presence in these batteries of connections of fluorine, arsenic, etc., and also toughening ecological requirements to waste products of a various origin puts forward a problem of creation of technologies of safe neutralization and recycling fulfilled of lithium sources of a current with reception of valuable secondary materials. In the given work as us processing fulfilled lithium batteries of system $Li/LiBF_4$-$(BL/(CF_x)_n$, in particular processing of their cathodic part representing fluoride of lithium intercalated into a graphite matrix, formed is considered at the category of the battery:

$$nxLi^+ + nxe + (CFx)\ n = nLiF + (C)n \qquad (1)$$

In view of that circumstance, that in structure lithium batteries the contents of lithium exceeds the contents of fluorine in polyfluorocarbon, reaction 1 proceeds substantially therefore there is a formation of graphite with intercalated fluoride lithium. Separate analyses had been established, that after a stage of the category the contents of fluorine in the carbon matrix, not connected with lithium, can be finished with scornfully small values which are taking place on the verge of an error of definitions.

We had been executed calculations of electronic and spatial structure of the graphite containing intercalated fluoride lithium. Results of calculations show, that irrespective of the chosen model energetically formation dimmers $(LiF)_2$, introduced in space between graphen layers and inverted by ions of lithium aside these layers is more favourable.

The last is caused, probably, a partial overflowing of electronic density of aromatic rings on vacant orbital the lithium, accompanying with a prize of energy from 42 up to 49 kD on one mole LiF depending on the chosen model. The received data specify perspectivity of use Lewis acids for destruction klasters in the way deintercalation of fluoride lithium. Us it is offered to carry out extraction of fluoride lithium from carbon matrixes of the cathode solutions fluoro- Lewis acids in organic solvent (for example 1,2-dimetoxiethane). Advantage of the chosen method deintercalated of fluoride lithium is the opportunity of processing of a firm phase carbon - fluoride of lithium with reception of solutions fluorocomplex salts of lithium in 1,2 dimetoxiethane which can find application in quality electrolits for lithium sources of a current. Carbon can be repeatedly used in quality filling in gum-technical products or as the additive to electrodes of chemical sources of a current.

With use of methods of a nuclear magnetic resonance ^7Li and the chemical analysis we investigate processes of interaction LiF, intercalated in a matrix of the graphite cathode, with solutions of trifluoro boron (BF_3), pentafluoride phosphorus (PF_5) and pentafluoride arsenic (AsF_5). Lewis's specified acids dissolved in 1,2-dimetoxiethane at the lowered temperature, with the purpose of prevention destruction solvent. Reaction carried out in fluoroplastic vessels with the designed quantities of acids at hashing. Through the certain time intervals reaction stopped fast division of phases into the vacuum filter, and a firm and liquid component subjected to the analysis. Occurrence in solutions of signals from nucleus ^7Li is the conclusive proof of course of process of formation in system of soluble salts of lithium. Methods of the chemical functional analysis had been proved formation in a solution tetrafluoroborate lithium, at use as Lewis's BF_3 acid, hexafluorophosphate lithium at use PF_5 or hexafluoroarsenate lithium at use AsF_5.

At processing a cathodic material by solutions fluoro- Lewis's acids there is an extraction of fluoride of lithium from a carbon matrix due to course donor-accept interactions of fluoride of lithium to Lewis's acid with reception well soluble in the given system of salts of lithium. Most effectively process of dissolution proceeds at interaction of fluoride of lithium with AsF_5 that can be explained by greater force AsF_5, than BF_3, PF_5 in reactions on donor-accept to the mechanism. Application of all acids of Lewis offered by us allows to receive solutions fluorocomplex salts of lithium which find application to quality of electrolits for lithium batteries.

Кinetic extraction of fluoride of lithium from carbon matrixes of the fulfilled cathode lithium batteries testifies to presence of two stages essentially distinguished on speed and the mechanism. We also had been investigated influence of a lot of factors on speed of course of process of extraction of fluoride of lithium from carbon matrixes of temperature, ratio of reagents, concentration of acids. Despite of kinetic difficulties, process of extraction of fluoride lithium by solutions of acids under certain conditions proceeds quickly enough, that enables applications of the way of processing of cathodes offered by us fulfilled lithium batteries in industrial scale.

The carried out experiments with not water solutions, has shown high efficiency of extraction of fluoride lithium from fulfilled cathode lithium batteries and with the help of solutions of acids of Lewis (BF_3, PF_5, AsF_5) in organic solvents. Significant advantage of application of such method of processing will consist in absence of water, presence even which insignificant quantities in electrolit lithium batteries makes unsuitable operation of such batteries. Conditions of carrying out of process in not water environments have been fulfilled and optimized with the purpose of quantitative extraction of fluoride of lithium and high quality maintenance of products received at it.

The offered method of processing fulfilled lithium batteries of system allows to carry out full neutralization of the given type of waste products with reception of a lot of the commodity products using significant demand in manufacture lithium of batteries and other branches.

The literature

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