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INFORMATION ABOUT PASSIVATION OF LITHIUM THIONYL CHLORIDE (LI-SOCL2) BATTERY

The following information is about passivation of lithium thionyl chloride battery for the reference.

1, General Introduction About Passivation.

Passivation is a chemical term and it refers to phenomena that a kind of chemical film appears on the surface of the metal and prevents the further corrupt from happening on the surface of the metal.

In lithium thionyl chloride battery, thionyl chloride is liquid. Metal lithium gets in touch with thionyl chloride completely and will slowly rust just like iron. The production of this rust is lithium chloride.

The lithium chloride produced on the surface of the metal lithium in thionyl chloride is very compact and prevents the reaction of lithium and thionyl chloride. This phenomenon is passivation.

The passivation of lithium thionyl chloride battery happens as soon as the battery is produced, but this reaction is not fast in speed. Just like all the chemical reaction, the speed of passivation is related to the temperature. The higher the temperature is, the faster the speed is. The longer the time is, the more serious the passivation is.

2, The Effect Of Passivation On Battery Performance.

Passivation is the inherent character of lithium thionyl chloride battery. Without passivation, lithium thionyl chloride battery can not be stored. Because the lithium chloride produced on the surface of the metal lithium in thionyl chloride is very compact and prevents the reaction of lithium and thionyl chloride, the self-discharge inside the battery becomes very small. This way, the shelf life of the battery can be over 10 years. This is the positive side of the passivation. So passivation can protect the battery capacity and will not cause capacity loss.

But there is also negative side of passivation. The following is the disadvantages of passivation on appliances.

1) When the battery begins to be used after being stored for some time, the initial working voltage of the battery will be low. It will take some time before the initial working voltage of the battery reaches the required value. This is what is called “voltage passivation”. Voltage

passivation does not take too much effect on the purpose that is not strict with time. But for the purpose that is strict with time, some fatal defect might appear if there is improper use, such as weapon system etc.

2) Passivation do not have much effect on the purposes that do not require big change of the current. For the purposes that accidentally require some changes on the current, it can be said to a fatal defect if there is improper use, such as brainpower water meter, ammeter etc.

3) For the use of micro current, the capacity loss will be big and the utilizing rate of the active matter will reduce. In the operational condition of the battery, the passivation will go on continuously. That is to say, the active matter lithium and thionyl chloride that are used for reaction will be consumed continuously, and it will make the capacity reduced. Generally speaking, the utilizing rate is high when the battery is used up with in 3 ~ 6 months and can reach about 90% of the designed capacity. The utilizing rate of the battery capacity can only be about 65% when the battery is used for above 5 years.

3, Way To Solve The Passivation.

The character and performance of battery must be known before battery is used. Otherwise, it will be difficult to reach the aim.

1) For the purpose that requires a long-term nonuse of battery, such as weapon system and communication system. The battery can be activated every half year or the battery can be activated to the normal working voltage before being used. This way, the voltage passivation can be solved.

   Special instrument, circuit or manual way can all be used for activation. The principal for activation is to discharge the battery to reach the required working voltage. The discharge current normally is 1~3 times of the working current required by the system. It will be all right if the voltage of the single battery reaches 3V during discharge. The time for activation shall not be more than 5 minutes. If in 5 minutes the battery with half-a-year's storage cannot be activated, the battery cannot be used and has to be replaced.

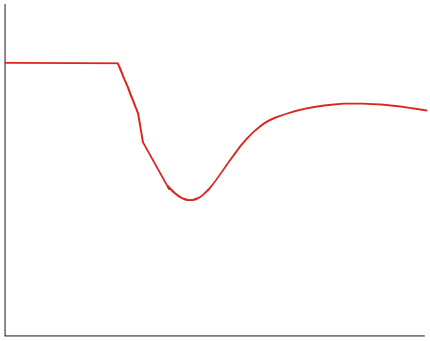
   The battery in the weapon system can be activated by the above way. The battery in the communication system can be activated by the above way, and the battery in communication system can be also activated by several-repeated receive-and-dispatch before use.

2) Normally the instrument controlled by microcomputer CMOS chip is in the working condition of micro current, accidentally there is changing current pulse required. If there is improper handling in design, the abnormal condition or instrument death might be caused, and at last battery capacity will be consumed out and battery will be out of use. The key to solve this problem to activate the battery at regular intervals when the hardware and software of the instrument are designed. It is based on the designer's knowledge on the

battery passivation.

For the designer of the instruments controlled by microcomputer CMOS chip, there is some experience for the reference.

a) In application, the battery passivation can not be solved only by supplying around 10 microampere current. If big current is needed and the passivation film inside the battery is very thick, the battery voltage might be lower than 1.8V, the microcomputer CMOS chip can be caused to die. Please refer to the following diagram. To solve such problem, the battery has to be activated on line.



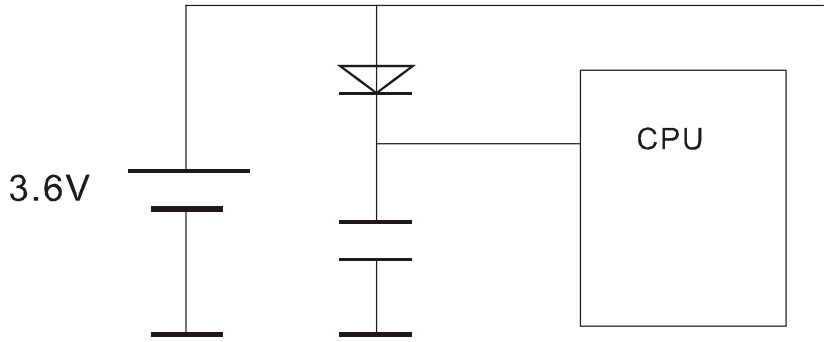
There are many ways for on-line activation. The convenience is in software design. For brainpower gas meter, water meter, the way is the following. Drive the valve 2 times every month, 0.5~1s every time. The voltage of battery shall be measured every time at the end of this action. If the voltage is lower than 2.7V, it means that the capacity of the battery is nearly out and the valve has to be closed immediately. The end voltage of the battery must be measured at the large current condition and it is of no use to measure in micro current condition. Because under micro current condition, the working voltage of the battery is about 3.6V, if there is a reduction (even to 3.5V), the capacity of the battery is out and there is no way to close the valve.

The loading ability of the battery within 90% of the capacity basically holds steadily. Under the condition of big current, the voltage of the battery normally is above 3.0V if the battery is in the activated state.

For the instruments which is in fixation and cannot be rewritten, the most simple way is to draw out a discharging circuit made up from audion and resistance from the place of writing data I/O of E^2PROM. It will be all right if the current of the discharging circuit is equal to the maximum working current of the instrument. But this method is no good in effect for the instrument which is in nonuse for a long time.

B) For the circuit that requires both large current and micro current from one battery, the following diagram is suggested in circuit design. The principal of the diagram is simple. Use one germanium diode and a 220μF capacitor to make CPU electrical source. No matter what big changes the outside circuit can cause, the voltage on CPU can basically

keep unchanged in a short time. Under the condition that all I/O ports have low electrical level output, the voltage on capacitor can keep CPU to work normally for more than 45s.



The effect will be good if the above A and B can be integrated.

3) In the state of micro current discharge, the utilizing rate of the lithium thionyl chloride battery is low. So in the selection of battery models, the utilizing rate of the battery shall be considered to avoid the problem that the battery can not reach the designed time for operation.

The test results show that the lithium thionyl chloride battery can only be used for 8~9 years under the micro current working station. It is also a very important element for the design of instruments.

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