Coated lithium powder (CLiP) electrodes for lithium-air cells

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One of the big problems in our century is the scarcity of fossil fuels. Renewable energy sources in combination with batteries are therefore getting more and more attractive for energy production and storage. Batteries are used in portable electronic devices as well as in the automobile industry. For automobile applications lithium-air batteries are one of the promising candidates for electrochemical energy storage, due to their theoretical energy density (11.680 Wh/kg) in comparison to the one of gasoline (13.000 Wh/kg.).[1]

In general, a lithium-air battery consists of a lithium metal anode, an electrolyte and a porous carbon air cathode.[2] During discharge, oxygen is reduced at the cathode and lithium is oxidized at the anode.

$$2Li + O_2 \rightleftarrows Li_2O_2$$

According to the type of electrolyte, lithium-air batteries can be categorized in four groups: non-aqueous, aqueous, hybrid (non-aqueous/ aqueous) and all solid state.[1] Safety issues still represent one of the key reasons why lithium-air batteries are still not commercially available. The commonly used lithium metal forms dendrites which may lead to a short circuit of the cell. The advantage of coated lithium powder (CLiP) compared to lithium foil is the suppression of dendrite formation due to the high surface area.[3]

Figure 1 shows a coated lithium powder (CLiP) electrode pressed on a copper current collector. Another safety advantage of coated lithium powder is that the mass loading of the lithium can be controlled and minimized during electrode processing. This means that there is no intrinsic excess of lithium necessary in the cell, which increases the safety of lithium metal batteries. Furthermore, the coating makes the electrode manufacturing safer and for battery companies more attractive to use.

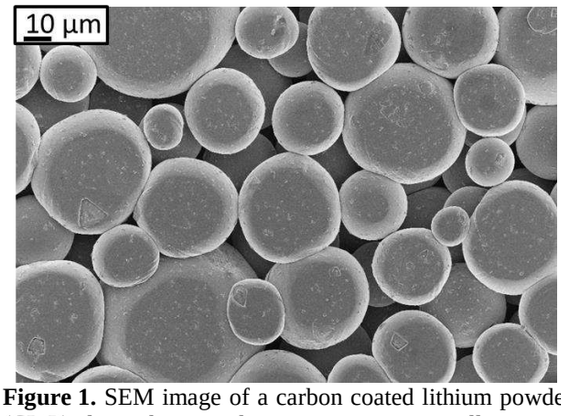

Figure 1. SEM image of a carbon coated lithium powder (CLiP) electrode pressed on a copper current collector.

In this work we will introduce coated lithium powder electrodes for the use in lithium-metal batteries. These electrodes will be compared to metallic lithium foil with regard to cycling behavior, coulombic efficiency and morphology changes during cycling. Furthermore, higher current densities up to 1 mA were investigated to prove the high power application of the coated lithium powder electrodes.

References

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