Rechargeable Lithium Batteries for Electro-mobility, What is Really Relevant?

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Li ion batteries can be considered as the most important and impressive success of modern electrochemistry. They are produced in billions of exemplars, power most of mobile electronic devices and are considered safe and reliable (i.e. meeting very well the official specs of most of their producers). Their general failure is in fact below the ppb level. This energy storage & conversion technology faces now the great challenge of powering electric vehicles. In fact, the success of the electro-mobility revolution depends on the availability of rechargeable batteries possessing high enough energy density, demonstrating very prolonged cycle life, having very good safety features and reaching low enough cost (numbers will be discussed in the talk). Examining the field of energy storage and power sources makes clear that Li ion batteries are the most promising technology that can meet these challenges. Naturally, the big challenges ignite the imagination, many new ideas related to Li ion batteries are flooding the scientific and patents literature and it seems that the field suffers from lowering the signal-to-noise ratio of the information which is published in recent years. This presentation aims at making some order, explaining what is the real horizon for rechargeable Li batteries that can promote the electrochemical propulsion revolution. The talk will review briefly the recent renaissance related to Li metal anodes, showing very impressive results, but we will emphasize the risks. It seems clear that carbonaceous anodes still provide the best option for negative electrodes and in this respect we will discuss possible operation of Li ion batteries at very low temperatures. In the field of electrolyte systems, solid electrolytes and highly concentrated solutions focus attention, however, for electro-mobility we will have to stay with conventional liquid electrolyte solutions, with fluorinated solvents as being very promising. The limiting factor and the main challenge as well is the cathodes side. Here the trends are clear. The NCM type cathodes - $Li_{1+x}Ni_yCo_zMn_{1-x-y-z}O_2$ materials are the most important ones in two directions: the Ni rich ($x = 0$, $y \rightarrow 1$) and the Li & Mn rich ($0.1<x<0.2$; $1-x-y-z > 0.5$) families of these materials promise the necessary high specific capacity and high energy density for advanced Li ion batteries, while suffering from intrinsic stability problems [1-3]. We will demonstrate how by doping and coating both types of cathode materials can be stabilized. Thus, modified high capacity NCM cathodes mark a real promising horizon for advanced Li ion batteries for EV applications. Finally, we are discovering in recent years the importance of binders and active separators as components that contribute to the stability of advanced batteries [4].

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