Radiolysis as a solution for accelerated ageing studies of electrolytes in Lithium-ion batteries

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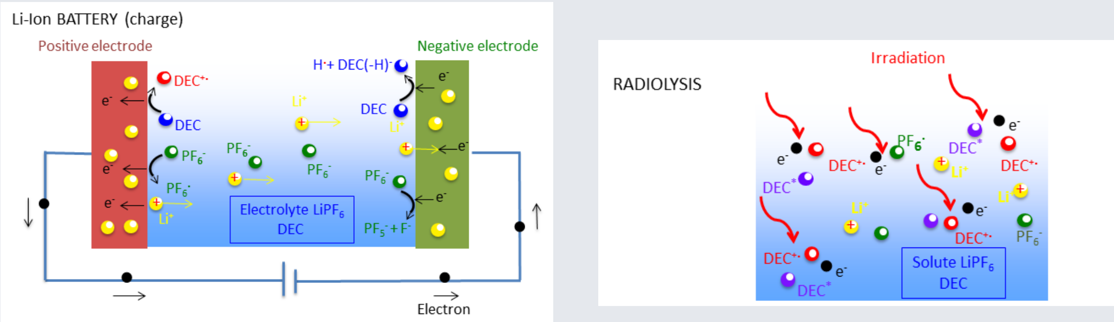
Among many energy storage devices, Lithium ion batteries (LIBs) are efficient power sources used for various applications including mobile microelectronics i.e. phones and laptops. However, ageing phenomena causing loss of performance are not yet fully understood. However, these phenomena are a crucial issue related to providing safe and stable batteries.



Comparison between primary electron transfers at the electrodes in the electrolytic charge/ageing processes of a Li-ion battery (in $LiPF_6$ 1 M/diethylcarbonate $C_2H_5OCOOC_2H_5$ (DEC) solution as a model electrolyte) (left), and after ionization in the bulk during radiolysis with the same medium (right)

LIBs are usually composed of an electrolyte, a lithium metal oxide cathode and an anode where the active material is often graphite. Nevertheless, the ageing studies are lengthy, costly, and most often purely qualitative. We have demonstrated that radiolysis (i.e. the chemical reactivity induced by the interaction between matter and ionizing radiation) is a powerful tool for a short-time identification (within minutes-days) of the by-products occurring from the degradation of a LIB electrolyte after several weeks-months of cycling. Indeed, we have shown that the highly reactive species created in the irradiated solution are the same as the ones obtained during the charging of a LIB using similar solvents. Radiolysis also enables experiments at the picosecond time scale, giving thus access to reaction mechanisms. Therefore, radiolysis is a promising tool to rapidly simulate the ageing behavior of LIBs and facilitate the development of next generation batteries.

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