Ageing in Lithium-ion batteries: the point of view of a radiation chemist

Sophie A Le Caër

Ageing in Lithium-ion batteries: the point of view of a radiation chemist

Sophie Le Caër

LIONS, NIMBE, UMR 3685, CEA, CNRS, Université Paris-Saclay, CEA Saclay Bât. 546, F-91191 Gif-sur-Yvette Cedex, France

Due to the limited reserves of fossil fuels (natural gas, coal and oil) for its energetic needs and due to environmental concerns, mankind has to use energy in a sustainable manner. Therefore, the conversion and storage of energy is necessary. The most used devices to store energy are now electrochemical batteries. Among them, lithium-ion batteries (LIB) have been commercialized since 1991 and are widely used. That is why the study of ageing and degradation mechanisms in LIB is a crucial issue. Nevertheless, the ageing studies are lengthy, costly, and most often purely qualitative. Recently, we 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. More recently, we have used suspensions of electrolyte containing active materials which mimic the surface of the electrode. We have evidenced that these irradiated solutions lead to the formation of a solid electrolyte interface at the surface of the material. Moreover, the simultaneous analysis of the products formed in the gas and in the liquid phase provides a global picture of the phenomena at stake during ageing.