AlF_3 coatings of the active materials for the aqueous rechargeable lithium-ion batteries

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In the past several decades, the lithium-ion batteries (LIBs) are considered as potential use in various energy storage systems (ESSs) including portable devices, medical equipment and transportation systems such as electric vehicles (EVs) [1]. However, LIBs have critical limitations in the large-scale application due to the flammable, toxic, low safety, high cost, high non-aqueous electrolyte resistivity compared to the aqueous electrolyte solutions which are most crucial limiting factors. Therefore, the aqueous rechargeable lithium batteries (ARLBs) are attractive candidates to solving these issues such as high cost of electrolyte and safety of the batteries system and also operation in a wide temperature range [2]. However, from point of view practical energy storage devices, the ARLBs can't be maintained the high cyclic and rate capability performance due to the formation unfavorable side reaction components on the surface of the active materials into the aqueous electrolyte solutions. Among of various approaches for the improvements of the surface stabilization of the anode and cathode materials of the ARLBs are the surface modification of the surface of the particles of the active materials. Therefore, in this work, in combination with the physicochemical (XRD, SEM, EDS, XPS, ICP) and electrochemical analysis, the performance of the anode and cathode materials such as LiV_3O_8, $LiFePO_4$ and $LiMn_2O_4$ were improved by AlF_3 coating material as shown in Figure 1. On basis of these data, we can conclude that the AlF_3 coating significantly reduces dissolution of the metal ions and the surface failure by surface stabilization of the materials in the aqueous electrolyte solution. Moreover, it can suggest that the AlF_3 coating material can prevent the formation of the unfavorable side reactions components and facilitate the lithium-ion diffusion leading to reduce the surface resistance and improves the surface stability of the pristine active materials with the enhanced electrochemical performance in the aqueous electrolyte solutions.

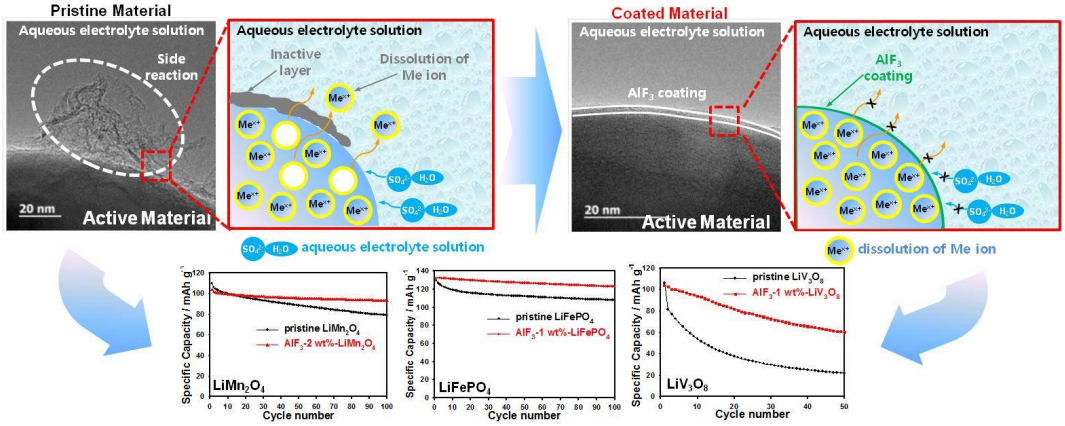

Figure 1. The performance of the pristine and coated active materials in the aqueous solution.

References:

[1] M.R. Palacin, Chem. Soc. Rev. 38 (2009) 2565-2575.
[2] W. Li, J.R. Dahn, D.S. Wainwright, Science 264 (1994) 1115-1118.