Research Title:

Studies of Advanced Lithium-Ion Batteries for Electric Vehicles: Modification of Li, Mn-rich Cathode Materials with Surface Coatings via Atomic Layer Deposition

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We propose a collaborative development between Aurbach's group (BIU) and Ein-Eli's group (Technion) in this work, to implement and investigate surface modification of high energy cathode based on high Ni content in nickel-cobalt-manganese oxide materials (HE-NCM) for advanced Li-ion batteries. These materials are proposed to be modified in the collaborative work between the two institutions by thin inorganic coatings via atomic layer deposition (ALD) technique. Following the implementation of ultra-thin robust coating layers, the modified HE-NCM will be studied by analyzing the electrochemical behavior in comparison with the bare HE-NCM materials in Li half-cells and in Li-battery prototypes with graphite anodes at 30°C and 45°C. The aim is to optimize the properties of the coatings, while studying the structure, morphology and composition (XRD, TEM, SEM, XPS) that will allow deep understanding of the role of the developed coatings in stabilizing the electrochemical cycling behavior of HE-NCM cathodes. Such effort will lead to the introduction of enhanced battery durability with an extended distance driven electric vehicle. We propose the following coatings by ALD on HE-NCM materials: lithium sulfate Li_2SO_4, lithium phosphate Li_3PO_4, lithium fluoride LiF, lithium aluminate ($LiAlO_2$/Li_5AlO_4), lithium aluminum fluoride ($LiAlF_4$/Li_3AlF_6), sodium aluminate ($NaAlO_2$/Na_5AlO_4), and sodium aluminum fluoride ($NaAlF_4$/Na_3AlF_6).