ALD Grown Buffer Layer's Importance for Magnetron Sputtered $LiCoO_2/Li_7La_3Zr_2O_{12}$ in All-Solid-State Lithium-ion Batteries

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Traditional lithium-ion batteries pose stability and safety limitations due to liquid electrolytes resulting in leakage, flammability, and limited electrochemical stability. ASSLIBs overcome these issues by replacing liquid electrolyte with solid-state materials, significantly reducing the risk of dendritic growth, and therefore, enhancing safety and energy efficiency issues.

ARISER focuses on controlled deposition of $LiCoO_2$ (LCO) as a cathode and $Li_7La_3Zr_2O_{12}$ (LLZO) as a solid electrolyte. It concentrates on development of a dual-deposition system as RF magnetron sputtering for LCO and LLZO, and thermal evaporation for lithium metal. Interface between LCO and LLZO layers is in a particular focus, as the quality and consistency of it affects the ionic conductivity and cell performance[1]. Optimizing interfacial layer through atomic layer deposition (ALD) technique, ARISER introduces nano-layered thin film buffer enhancing interfacial adhesion and stability, that is essential for reducing resistance and improving charge transfer[2].

Extensive characterization techniques are implemented to evaluate the deposited films' structural, chemical, and electrochemical properties using Scanning Electron Microscopy (SEM), X-ray diffraction (XRD), Raman spectroscopy and X-ray Photoelectron Spectroscopy (XPS). XPS provides insights into surface chemistry and elemental composition. Electrochemical measurements including cyclic voltammetry and impedance spectroscopy are performed to gauge ionic conductivity and charge-discharge efficiency, allowing for real-time optimization of the cell's operational parameters[3]. By advancing deposition techniques and fine-tuning of interfaces, ARISER contributes to the development of durable, high-capacity batteries that align with industrial standards for next-generation energy storage. These developments pave the way for broader adoption of ASSLIBs in various applications, from portable electronics to electric vehicles, where safe, high-density energy storage is paramount.

This work was supported by EUROPEAN UNION under MERANET with TUBITAK project number of 122N410. The authors would like to acknowledge the facilities of Research and Application Center for Quantum Technologies (RACQUT) of IZTECH.

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