EXPLORING THE INTERFACIAL BEHAVIOR OF ALUMINUM ELECTRODES IN IONIC LIQUIDS: AN IMPEDANCE STUDY

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With the ever-growing demand for electrochemical energy storage devices, the development of low-cost novel materials dominates the energy market to attract more attentions. Aluminum with high abundance in earth's crust becomes an attractive alternative metal material especially for lithium battery market [1]. However, aluminum either as anode or current collector in energy storage devices still remains some issues. Pristine aluminum intrinsically covered by a passive oxide layer can both limit the exposure of the metallic surface and increase the contact resistance [2]. Another issue is about electrolyte for Al technology, such as commonly used chloroaluminate-based ionic liquids (ILs) which are highly corrosive aggravating their limitation as an efficient battery electrolyte [2]. Considering the above, it is of importance to address the interface between Al and chloride ion free ILs especially in the presence of covering layer. After all, most electrochemical processes in principle take place at electrode │electrolyte interface. In this work, the electrochemical behaviour of Al(111)│IL interface has been studied by cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) methods. From the EIS results, relatively low capacitance values indicate that the fully metallic Al surface cannot be obtained from the ILs under this study. Interestingly, the capacitance values can be clearly distinguished from the different anions ($TFSI^-$, BF_4^-, ClO_4^-), suggesting that passive layer thickness is related with both the anion size and the formation of Al–related compounds.

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References

[1] T. Leisegang, F. Meutzner, M. Zschornak, W. Münchgesang, R. Schmid et.al., 2019, Frontiers in Chemistry, 7, 268.

[2] Y. Zhang, S. Liu, Y. Ji, J. Ma and H. Yu, 2018, Adv. Mater. 30, 1706310.