Design of an effective air electrode using highly porous carbon-aerogel on carbon cloth for oxygen intake towards improved reaction kinetics of aluminum-air battery

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Abstract

One of the greatest alternatives to Li-ion batteries is an Al-air battery. The aluminium (Al) is more effective as a battery because of its viability and nontoxicity. The design of cell and electrode stacking affect the performance of Al-air battery. The present study focuses on designing an efficient air cathode host to lengthen the battery's lifespan using highly porous carbon aerogel. Initially, the carbon aerogel (CA) material is synthesized using sol-gel polymerization process and characterized using XRD, SEM, and BET. The synthesized CA is used to fabricate the electrode stacking using the in-house-built Al-air cell. The performance of carbon aerogel coated on carbon cloth as air cathode has been evaluated using a galvanostatic discharge of the assembly at different current rates, and the specific capacity is recorded. The highest specific capacity observed is ~ 683 mAh g-1 at 2.551 mA cm $^{-2}$ current density. The acquired results demonstrate the superiority of the present electrodes material compared to currently used air electrode. The improved electrochemical stability and the robust pore network in CA allow oxygen to pass through the cathode end for chemical reaction. Overall, this enhances kinetics and makes the interactions between oxygen and aluminum to generate higher current because of relatively faster chemical reaction.

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