2021-03-25 15:02:53

International Conference on Lithium-Sulfur Batteries, June 28–July 1, 2021

Topic: New cell components
Type: Poster presentation
Abstract no.: A-124
Status: submitted
Supported by:

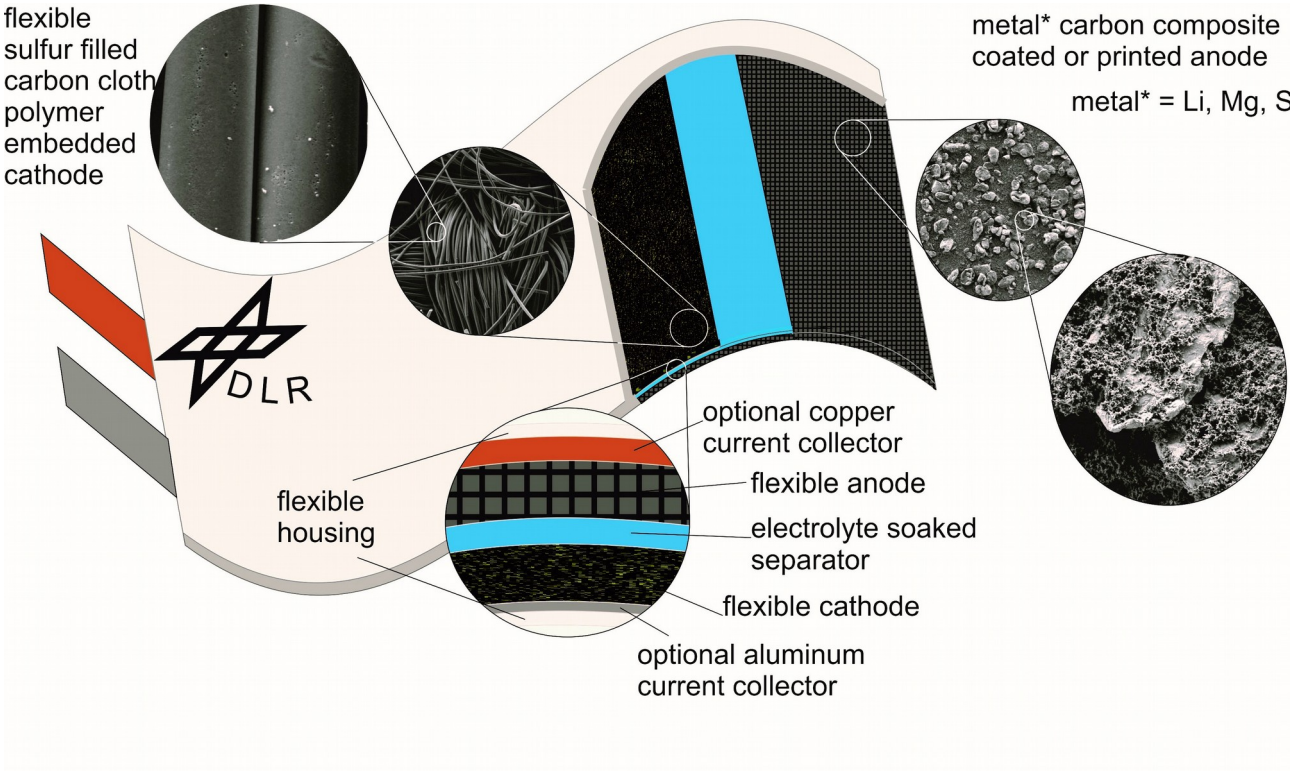
Innovative nanostructured materials and flexible electrodes for next-generation batteries

B. Sievert[1], M. Nojabaee[1], I. Nicotera[2], A. Arenillas[3], N. Wagner[1], K. A. Friedrich[1]
[1]German Aerospace Center / Institute of Engineering Thermodynamics, Electrochemical Energy Technology, Stuttgart, Germany, [2]University of Calabria, Department of Chemistry and Chemical Technologies (CTC), Calabria, Italy, [3]Institute of Carbon Science and Technology, INCAR-CSIC, Oviedo, Spain

Within the BMBF-funded international collaborative project INNENERMAT, the partners are developing flexible batteries and supercapacitors and proof-of-concept for the hybridization of mentioned systems in a multidisciplinary approach. Safe and environmentally friendly high-performance cathodes and anodes, gel and polymer electrolytes and smart carbon textile electrodes for flexible energy storage cells are realized through the development of advanced functional materials. Here the primary results on the development of lithium sulfur battery component within INNENERMAT project are presented.

Carbon xerogels with different size of feeder pores were developed and designed with defined amount of microporosity for immobilization of sulfur species within the cathode [1]. Preparation and associated effect on the electrochemical performance of such electrodes is investigated. To this end, the influence of preparation method such as grinding, handling, stability and viscosity on the wet coating process as well as on the quality of cathode sheet in terms of defects and flexibility is discussed elaborately. Furthermore, the infiltration of sulfur into the carbon matrix is particularly studied for this innovative class of carbon materials [2].

In order to immobilize the polysulfide anions, the strategy adopted in this work is that of employing innovative single ion conductor-solid polymer electrolytes (SLIC-SPEs), providing suppressed anion mobility. For this purpose, lithiated Nafion-based nanocomposite membranes were synthesized via dispersion of nano-additives bearing suitable functional groups [3]. Two nanostructures have been investigated: graphene oxide (GO) and Nanoscale Ionic Materials (NIM) functionalized membrane. The presence of nanoparticles in the polymeric matrix is of great interest not only due to the significant gains in thermal and mechanical stability, but also the consequential barrier effect, hindering the diffusion of polysulfides and enhancing the cyclability of the cell. The implementation of these kinds of membranes have already been successfully demonstrated for lithium ion battery cathode and in the presented work the incorporation in the lithium sulfur system is showcased.



Cell setup for thin, flexible, environmentally benign high energy battery design for smart textile and wearable applications

References:
[1] Natalia Rey-Raap, Ana Arenillas, J. Angel Menendez, (2016), A visual validation of the combined effect of pH and dilution on the porosity of carbon xerogels, Elsevier, Microporous and Mesoporous Materials, 89-93
[2] Maryam Nojabaee, Brigitta Sievert, Marina Schwan, Jessica Schettler, Frieder Warth, Norbert Wagner, Barbara Milow, K. Andreas Friedrich, (2021), Ultramicroporous carbon aerogels encapsulating sulfur as the cathode for lithium–sulfur batteries, Royal Society of Chemistry, Journal of Materials Chemistry A, 6508-6519
[3] Isabella Nicotera, Cataldo Simari, Marco Agostini, Apostolos Enotiadis, Sergio Brutti, (2016), A Novel Li+-Nafion-Sulfonated Graphene Oxide Membrane as Single Lithium-Ion Conducting Polymer Electrolyte for Lithium Batteries, The Journal of physical chemistry, 27406−27416

Authors

First author: Brigitta Sievert
Presented by: Brigitta Sievert
Submitted by: Brigitta Sievert