Final Report

Project acronym: *SLIM-FIT*

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M-ERA.NET Call 2020

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Publishable project summary

Main objective was to establish an advanced battery cell design based on innovative, interpenetrating electrode and separator coatings aiming for stable and safe Lithium-Sulphur (Li-S) batteries for mobile applications. The concept uses a widely unexplored regime of "slim" electrode dimensions (10 µm – 20 µm thickness compared to 80 µm - 100 µm in state-of-the-art battery cells), specifically "fitted" to the requirements of high performance Li-S technology. This new concept is also demonstrated and evaluated in application-relevant prototype pouch cells.
Conventional Li-Ion-batteries and recent attempts to establish Lithium-Sulphur batteries are based on electrodes in a thickness range of 60 µm – 100 µm as double-sided coatings on metallic current collectors. In order to maximize the specific energy the passive weight of metal foils and separators are usually minimized through active material loadings levels exceeding 5 mAh/cm^2. The consequence is a high internal resistance and high areal currents causing fast degradation, e.g. when lithium metal anodes are applied. Goal of the project was to overcome the existing limitations in cell design by substituting metallic foils with light-weight nanocarbon current collectors. This concept enables high specific energies, even at low active material loadings. The challenge of reduced specific conductivity compared to metal foils needs to be compen-sated by an adapted cell design. The nanocarbon current collector not only represents a low weight current collector, but also an interpenetrating network for enhanced contact to the active materials. In fact, the carbon nanotube material with its high specific surface area and 3D-structure was found to be an ideal framework and sulphur host for efficient electrochemical conversion of the non-conductive sulphur species.
The "SLIM-FIT" concept challenges common sense in battery community concerning high areal active material loadings (>5 mAh/cm^2) being required in order to achieve reasonable energy density in Li-S-battery cells. Our innovative approach is based on a new generation of lightweight current collectors and functional components minimizing the passive mass and maximizing the active material utilization even on prototype cell level.