STRUCTURAL BATTERY COMPOSITES – ROLES OF CONSTITUENTS AND DEVICE ARCHITECURE

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ABSTRACT

Since weight reduction is vital in transportation, lightweight materials have been identified as key for successful electrification of road transport [1] and to meet the reduced emission demands for aircraft in year 2050 [2]. Reduced weight is required for increased range and energy efficiency of electric cars [3] and hence will facilitate reductions in battery volume and mass. Although the introduction of composites in electric vehicles is already underway, additional lightweight solutions for the vehicle systems are required, e.g. efficient energy storage solutions. Current battery systems add significant weight (typically 350 kg) to an electric car and reduce the interior volume. Furthermore, such systems do not contribute to the structural performance; i.e. they are structurally parasitic. Regarding aircraft, just 1kg reduction in the weight of each aircraft in the Lufthansa fleet would result in fuel savings of 30 tonnes of kerosene per year [4]. With this in mind, there is a compelling argument for materials with combined structural and added performance-linked capabilities, e.g. electric energy storage [5].

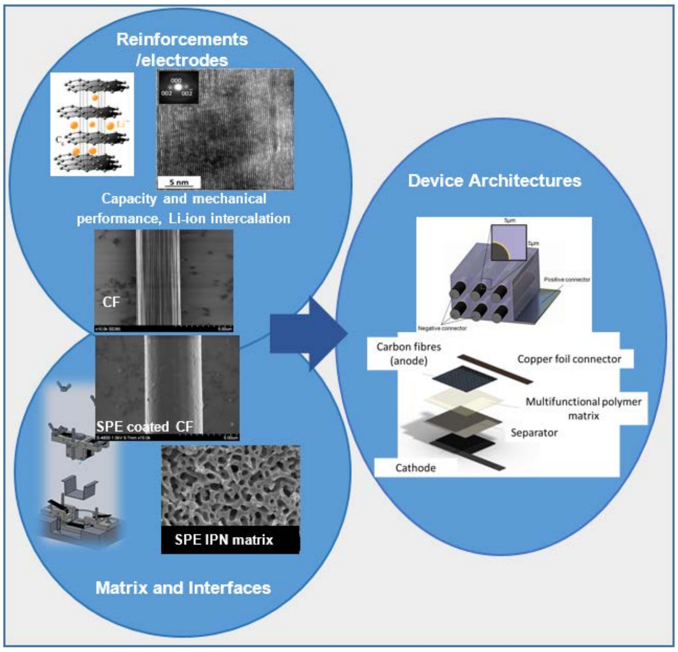

Figure 1: Research areas for realisation of structural battery composites.

Since year 2007 an interdisciplinary team of scientists across Sweden has performed research to realise multifunctional composite materials that simultaneously and intrinsically can carry mechanical loads and stores electrical energy – i.e. structural battery materials. Researchers at Chalmers, KTH, Swerea SICOMP and Luleå University of Technology have investigated different constituent materials, i.e carbon fibres and polymer matrix systems, as well as different material architectures to realise high performance structural battery composites [6-7]. In this keynote presentation, the author aims to provide an overview of the most reason results from this work. Figure 1 provides an illustration on issues to be addressed. Concerning the reinforcement/electrode material recent results linking the carbonaceous microstructure of different types of carbon fibres to their multifunctional performance capacities. Secondly, different polymer electrolytes as bulk matrix material or thin coatings are discussed. Finally, a brief assessment of different material device architectures is to be presented.

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Biography

Dr Leif Asp, Chaired professor in Lightweight composite materials and structures at the Department of Industrial and Materials Sciences, Chalmers university of technology, Sweden. Professor Asp's research is focused on efficient design methodologies for carbon fibre composite aircraft and automotive applications and on development of novel multifunctional composites. The research builds on 25 years' experience in damage tolerance modelling, design and certification methods for aircraft composite structures.

Professor Asp is the current Senior Vice President of the International Committee on Composite Materials (ICCM) and former President of the European Society of Composite Materials (ESCM). Dr Asp is a member of the Editorial board of six international scientific journals, among these Composites Science and Technology. Before joining Chalmers full time in year 2015, Dr Asp had different positions at the Aeronautical Research Institute of Sweden (FFA) and Swerea SICOMP. He also held a position as adjunct professor at Luleå university of technology since 2004. In year 2014 Dr Asp was elected Fellow of the Royal Swedish Academy of Engineering Sciences – the oldest academy of engineering sciences in the World.