TH Monolithic printed supercapacitors for energy storage

Supercapacitors are energy storage devices able to provide high power. Compared to batteries, their cycle life is longer and they can be made of materials which are more sustainable. In practice, supercapacitors are electrochemical cells including two electrodes and ionically conductive electrolyte. The electrodes are porous and isolated by a porous separator allowing ions to move in the electrolyte.

InComEss develops supercapacitors utilizing the combination of printable electrical double-layer and pseudocapacitive electrodes: carbon/polyaniline-based composite electrode materials with enhanced capacitance. The reliability and fabrication method of the supercapacitors are enhanced by employing an innovative fabrication concept to manufacture inexpensive monolithic architectures by using screen printing technologies, eliminating the need of subsequent assembling steps employed in conventional fabrication processes. The monolithic supercapacitor structure is shown in Figure 1.

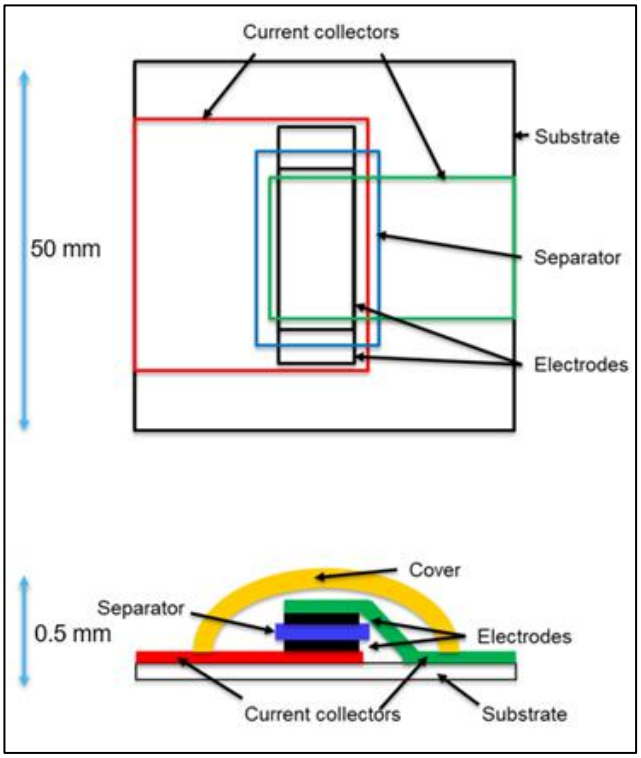

Figure 1: Schematic figure of monolithic supercapacitor structure: layout and cross-section[1]

The materials were chosen to be environmentally friendly and fabrication methods to be applicable in large scale manufacturing. More precisely, novel supercapacitor electrodes, electrolytes, barrier films, and separator materials have been developed. The manufacturing methods have included blade coating and screen-printing as well as atomic layer deposition for thin barriers to optimize the encapsulation of the supercapacitors.

[1] Figure owner Tampere University

This project receives funding in the European Commission's Horizon 2020 Research Programme under Grant Agreement Number 862597

Various activated carbon grades have been used in electrodes, e.g., Curved Graphene, from Skeleton Technologies. Leibniz Insititute of Polymer Research Dresden has synthesized Curved Graphene with various weight ratios of polyaniline to carbon on a larger scale, converted into inks and applied by stencil printing method for preparation of electrodes for supercapacitors. These electrodes are suitable for supercapacitors with the criteria of the electrical conductivity for fast electron transport, morphology for higher surface area and homogeneity, and specific capacitance, energy density, power density and cyclic performance.

The manufacturing optimization of monolithic supercapacitors has included material and process development at Tampere University. Current collectors, electrodes and separators have been fabricated by screen printing. Of these the screen-printing of separators was especially challenging, but good quality porous separators have been fabricated by applying inks developed in the project. Careful optimization of alignment and other printing parameters was necessary to successfully fabricate the monolithic structure. The printed supercapacitor without encapsulation can be seen in Figure 2.

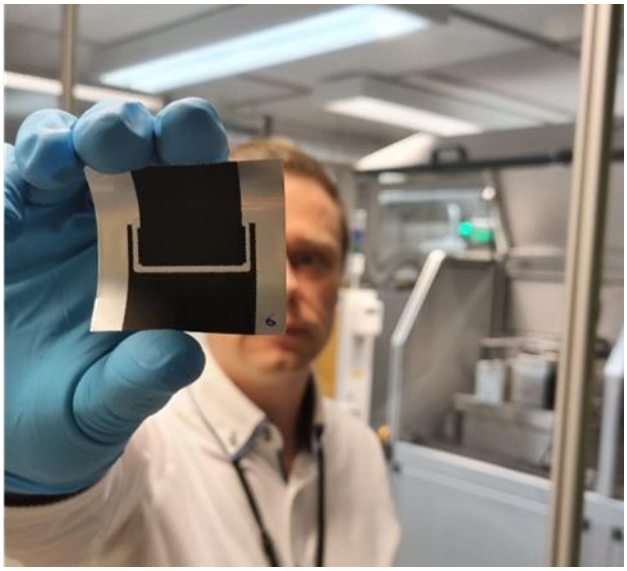

Figure 2: Monolithic supercapacitor structure fabricated by screen printing[2]

The work to test roll-to-roll printability is in progress at Centre for Nanotechnology and Smart Materials with electrode and separator inks delivered by Tampere University. The monolithic supercapacitors will be used to fabricate energy autonomous devices to be applied in demonstrators at Smart Material GmbH.

[2] Figure owner Tampere University

This project receives funding in the European Commission's Horizon 2020 Research Programme under Grant Agreement Number 862597

Details

Project title: INnovative polymer based COmposite systeMs for high efficient Energy Scavenging and Storage

Project ID: 862597

Start Date: 01/03/2020

Project Duration: 42 months

Follow us

For additional information please contact

Project Coordinator: AIMEN
Cintia Mateo | cintia.mateo@aimen.es

Dissemination & Communication Manager: Core Innovation
Ilia Kantartzi | ikantartzi@core-innovation.com

This project receives funding in the European Commission's Horizon 2020 Research Programme under Grant Agreement Number 862597