Nanostructured thick electrode strategies

Anukriti Pokhriyal, Rosa M. González-Gil, Leandro N. Bengoa, and Pedro Gómez-Romero
Institut Català de Nanociència i Nanotecnologia (ICN2), Campus de la, Universitat Autònoma de Barcelona, Edifici ICN2, Av. de Serragalliners, 08193 Bellaterra, Barcelona, Spain
anukriti.pokhriyal@icn2.cat

Abstract

This poster addresses the issue of bulk electrode design and the factors limiting the performance of thick electrodes. Indeed, one of the challenges for reaching improved performances in electrochemical energy storage devices (batteries or supercapacitors) is the maximization of the ratio between active to non-active components while maintaining ionic and electronic conductivity of the assembly. When it comes to the development of better ESS, for instance, emphasis is made on electrode composition, especially on the nature of the active phase, its microstructure and reactivity. Whether it is rechargeable batteries or supercapacitors, electrodes are invariably fabricated as thin solid coatings on thicker current collectors. It is evident that this is not an optimal design. Yet, the implementation of thicker electrodes has traditionally run into dead ends, either by failing to provide good performance with the same formulations used in the manufacturing of conventional thin electrode or by designing thicker but ultra-sophisticated nanostructures difficult to scale up and implement. Therefore, it is necessary and urgent to tackle the need for thicker electrodes through fundamental studies which could help understand the factors hampering their performance.

In this study, we develop and compare supercapacitor thick electrodes using commercially available carbons and utilising conventional, easily scalable methods such as spray coating and freeze-casting. We also compare different binders and conductive carbons to develop thick electrodes and analyse factors that determine the performance of such thick electrodes such as porosity and tortuosity. The spray-coated electrodes showed high areal capacitances of 1,428 mF cm-2 at 0.3 mm thickness and 2,459 F cm-2 at 0.6 mm thickness.

References

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Figures

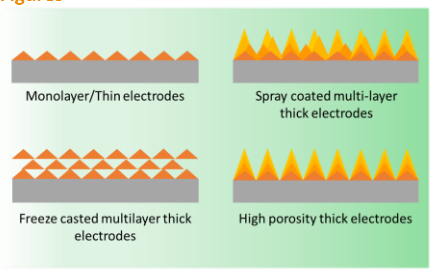

Figure 1: Schematic of multilayer electrodes structure impacting tortuosity

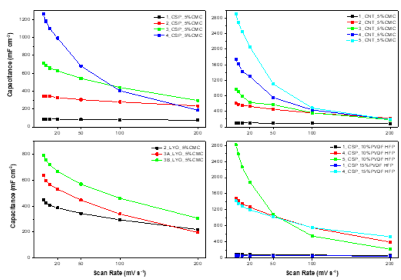

Figure 2: Areal capacitance at different scan rates for different thick electrodes.