Novel approach to build three-dimension supercapacitor using the suspensions and 3D printing technique

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Supercapacitors are emerging electrochemical cell devices to store energy and to be applied as power sources for self-sustainable wearable and portable electronics [1]. On the other hand, 3D printing offers fast and cheap prototyping of unconventional devices with the structural complexity and new solutions [2].

In this paper, we present the novel approach to build a supercapacitor composed of truly three dimension electrodes combining tw different techniques, i.e. 3D printing and injection method. The suspensions were used for the components of the supercapacitor, i.e. metal current collector and porous electrodes, while the 3D printed resin was used to build the housing. The design of the housing defines all three dimensions of the electrodes and in consequence the performance of the supercapacitor. As a separator between the electrodes there is an air gap filled with an electrolyte. Hence to this approach we were able to design and make various electrodes shape, expanded in all three directions, and next we were able to confirm the supercapacitor performance upon the electrode design (electrode shape, including dimensions and arrangement of the opposite alignement of the electrodes) and sort of the material. As an example: the results showed two different cyclic voltammograms with the charging-discharging loops, for two supercapaciors that differ with the shapes of electrodes and the electrodes arrangement (circle-like arranged radially and cuboid-like, arranged in parallel, Fig. 1). Finally, we discuss the potential and limitation of the presented method and future directions towards the supercapacitor application.

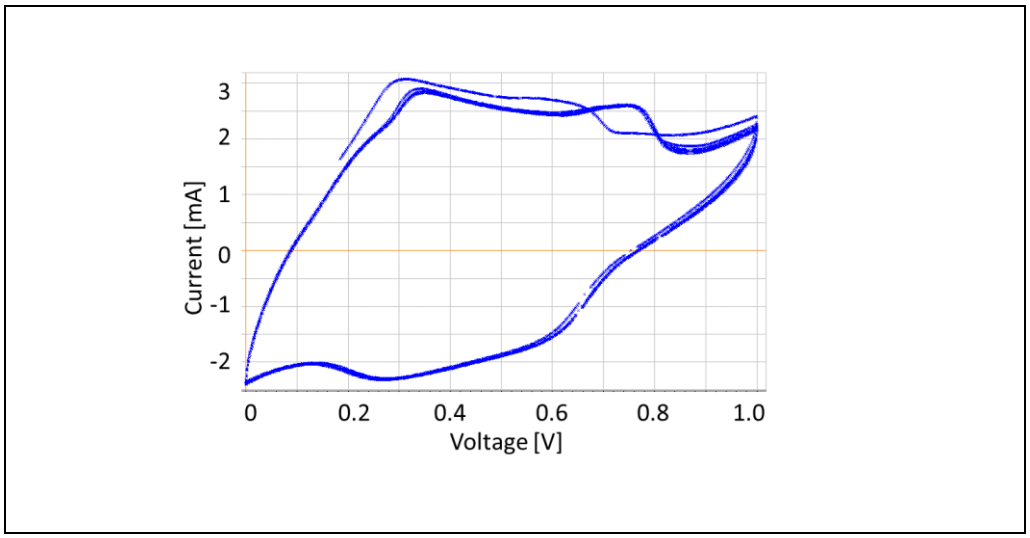

Fig 1. The graph presenting cyclic voltammetry (CV) for the supercapacitor with the circle-like arrangement of electrodes.

[1] Kyerematenge N. A., Brousse T., Pech D., Microsupercapacitors as miniaturized energy-storage components for on-chip electronics, Nature Nanotechnol., 12 (2017), 7-15
[2]] Vaezi M., Seitz H., Yang S., A review on 3D micro-additive manufacturing technologies, Int. J. Adv. Manuf. Technol., 67 (2013), 1721–1754