**Record in high-speed nanostructuring of electrodes for the increased active area and battery performance**

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**Abstract:** Fabrication of (3D) electrode architectures leads to a better electrochemical performance and operational lifetime in comparison to conventional 2D ones, due to an increased active surface area, reduced mechanical tensions during electrochemical cycling, and an overall reduced cell impedance. It can be utilized in many applications, including electric vehicles or stand-alone electric energy storage devices. Here laser structuring processes have great potential as a flexible tool able to fabricate details in the sub-micrometer range. However, despite the great potential of 3D electrode fabrication and demonstrated capabilities of lasers to produce them, the speed of laser micro and nanostructuring of electrodes is still low with respect to many industry standards. In this work, we introduce unique technologies combining high-energy pulsed ultrashort laser system HiLASE PERLA with beamshaping and multi-beam micro and nanostructuring technologies able to utilize different beam shapes or produce more than 40,000 beamlets to reach record speeds in nanostructuring of electrodes reaching productivity over 1900 cm2/min with structure detail below 750 nm. In the following pilot test, the fabricated nanostructure improved the performance of the oxygen evolution electrode in the means of stability compared to the catalyst, better adhesion of the catalyst on the surface, and improved the removal of oxygen bubbles.

**Keywords:** 3D electrodes, nanostructuring, multi-beam, beamshaping