High performance nanostructured carbon electrode for Vanadium Redox Flow Batteries

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The goal of the recently concluded COP26 in Glasgow is to reach zero net emissions of CO_2 by 2050. The only way to accomplish this task is to come up with a way to produce a continuous flow of carbon-free power. In recent years, we have seen an impressive progress in the deployment of renewable energy sources, and in particular of photovoltaics and wind turbines. However, renewable energies have some well-known drawbacks due to their intermittent nature and direct usage of the electricity generated would destabilize the grid. To overcome these problems large scale energy storage systems have drawn great attention in the last few years both from the academic and industrial world. Redox flow batteries (RFB) are one of the most recent and more promising electrochemical energy storage technologies. The Vanadium redox flow battery (VRFB) is one of the most promising technologies in the field of energy storage systems. Despite the many advantages, VRFBs have long suffered from low power density, mainly caused by the usage of electrodes which are not optimized for this application. In this work we propose a two-step process based on a plasma enhanced nano-aerosol jet deposition source. Starting from a gas precursor we deposit a nanostructured carbonaceous material on a commercially available substrate, this process allows to increase the current density to 400 $mAcm^{-2}$ with an energy efficiency of 80%, that is, 4 times greater than the commercial reference. The two-steps process permits a fine tuning of the properties and structure of the material and the formation of a carbon allotrope with exceptional catalytic properties known as Carbon Nano Onion (CNO).