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EFFECT OF CARBON ADDITIVES ON THE STRUCTURE OF ELECTRODES FOR HIGH ENERGY DENSITY Li-ION BATTERIES

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Energy storage technology based on lithium-ion electrochemical systems makes it possible to manufacture batteries with high specific energy and power densities. Over the past decades, such batteries have been the most widely used ones in applications related to electric vehicles, portable electronics, and robotics. Lithium-ion battery specific parameters can be significantly improved by reducing the mass contribution of inactive components, as well as by controlling the microstructure of the electrode layers. Using small-angle neutron scattering (SANS), the effect of conducting carbon additives (carbon black, graphene, and carbon nanotubes (CNTs)) on the porous structure of positive electrodes based on lithium iron phosphate (LiFePO4, or LFP) was studied. To separate scattering by closed pores from scattering by open pores, the electrodes were wetted with a deuterated electrolyte, which made it possible to match the scattering from open pores. The used additives were found to change the electrode porosity to different extents and affect the wettability of the material both through a different efficiency of the incorporation of the initial material into pores and due to a change in the LFP-matrix. Thus, CNT network embedded in the electrode layer provides its greater wettability by an electrolyte compared to widely used carbon black. This results in better electrode C-rate performance. The structure analysis allowed us to improve and optimize the technology of the fabrication of high areal capacity LFP-based electrodes. It was demonstrated that the use of CNTs as conductive additives opens prospects for producing electrodes with areal capacity of more than 5 mAh•cm−2 . The practical applicability of the considered electrode technology was approved on the pouch cell prototype with specific energy density of 150 Wh•kg−1 /295 Wh•l −1 .

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