

Carbon materials for energy storage systems working in aqueous and organic medium

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This presentation will be devoted to general overview of carbon materials applied for various energy storage systems such as electrochemical capacitors (EC) and Li-ion cells. The unique properties of carbon, i.e., electrical conductivity, tunable porosity, electrochemical stability are indispensable for wide electrochemical applications. Carbon materials are highly effective for ion sorption, insertion, intercalation processes due to their diverse porosity from ultramicropores to mesopores [1].

Capacitance values of EC are proportional to the surface of electrodes where ions are sorbed in the available pores. Hence, electrodes of symmetric electrochemical capacitors are based on activated carbons with a highly developed specific surface area (SSA), typically from 1000 m²/g to 2500 m²/g. The charge accumulated at electrode/electrolyte can reach ca. 100 F/g. Though, too high SSA would be responsible for low capacitance expressed per volume unit (F/cm³). For optimal EC performance, porosity of carbons should match ions sizes which depend on type of electrolyte (aqueous, organic), solvation, permittivity [2]. However, for quick charge propagation mesopores are useful. Additionally, for long lifespan of EC, carbon disorder and structural defects should be controlled [3]. The higher number of defects limits operational voltage range and cyclability.

For hybrid lithium-ion capacitor (LiC) or Li-ion cells, organic electrolyte in the form of two carbonates mixture is used and the graphitic carbon with a very limited porosity serve as an electrode material. In this case, surface of carbon is covered by solid electrolyte interphase during first cycles, then reversible intercalation of desolvated Li⁺ into graphite domains takes place. Such process allows long term cycling and supply energy for various portable devices and/or electric vehicles.

Acknowledgements

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References

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Topic:

Carbon in electrochemical processes and technologies (batteries and capacitors, fuel cells, functionalization, electrochemical sensors, etc.)
