Review: Charge Storage Mechanism in Nanoporous Carbons and Its Consequence for Electrical Double Layer Capacitors

P. Simon[1], Y. Gogotsi[2]

[1] Université Paul Sabatier de Toulouse, CIRIMAT, UMR CNRS 5085, Toulouse, France

[2] Department of Materials Science Engineering and A.J. Drexel Nanotechnology Institute, Drexel University, Philadelphia, USA

Achievement

We review past and present advances in the field of electrochemical double-layer capacitors (EDLC), so called supercapacitors, explaining how the breakdown of the traditional EDLC model for nanoconfined ions and ion desolvation accounts for the increase of capacitance for pores lower than a certain threshold that is dependent on the size of the ions in a certain electrolyte. We outline still open questions and provide guidelines for the optimization and future application of supercapacitors with improved power storage capabilities.

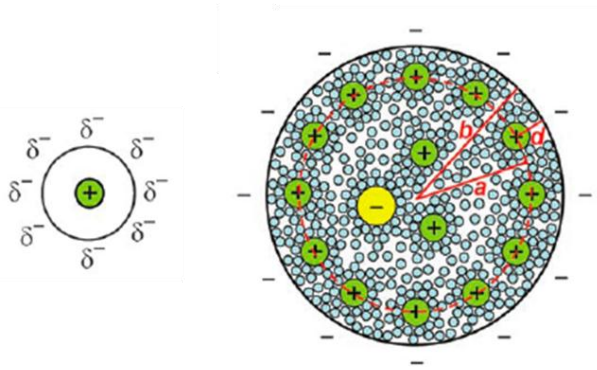

Fig. 1: Nanoconfined ions without solvation shell and solvated ions in larger pores (from left to right).

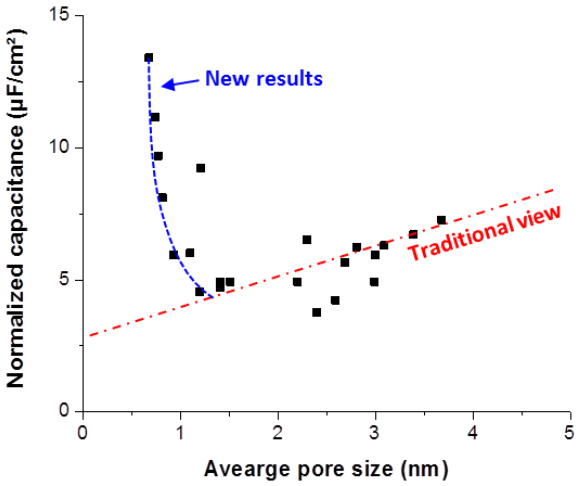

Fig. 2: Capacitance versus pore size plot illustrating the increase of the capacitance for ions in nanoconfinement.

Significance

Supercapacitors have shown great potential for highly efficient, high power-density energy storage. With the breakdown of the conventional EDLC theory for ions in nanoconfinement and solvation-shell stripping, this review paper provides guidelines for the interpretation of electrochemical performance of advanced carbon materials.

Credit

Reference: P. Simon and Y. Gogotsi, Philosophical Transactions of the Royal Society of London A, 2010, 368, 3457 - 3467. The effort at Drexel University is based upon work supported as part of the Fluid Interface Reactions, Structures and Transport (FIRST) Center, an Energy Frontier Research Center funded by the U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences under award no. ERKCC61.