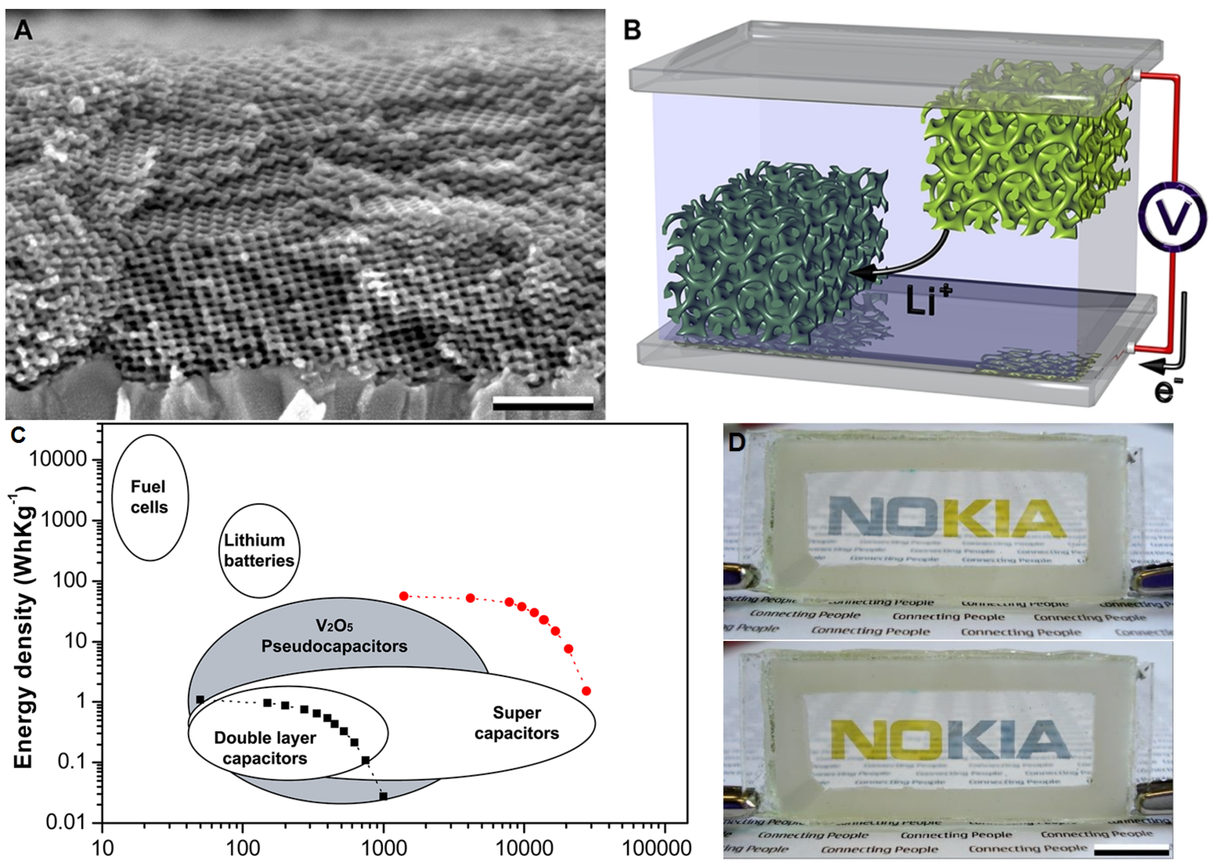
NRP 70 Transport and mobility

Nanostructured Lithium-ion batteries

Overview

Nanostructured electrode materials

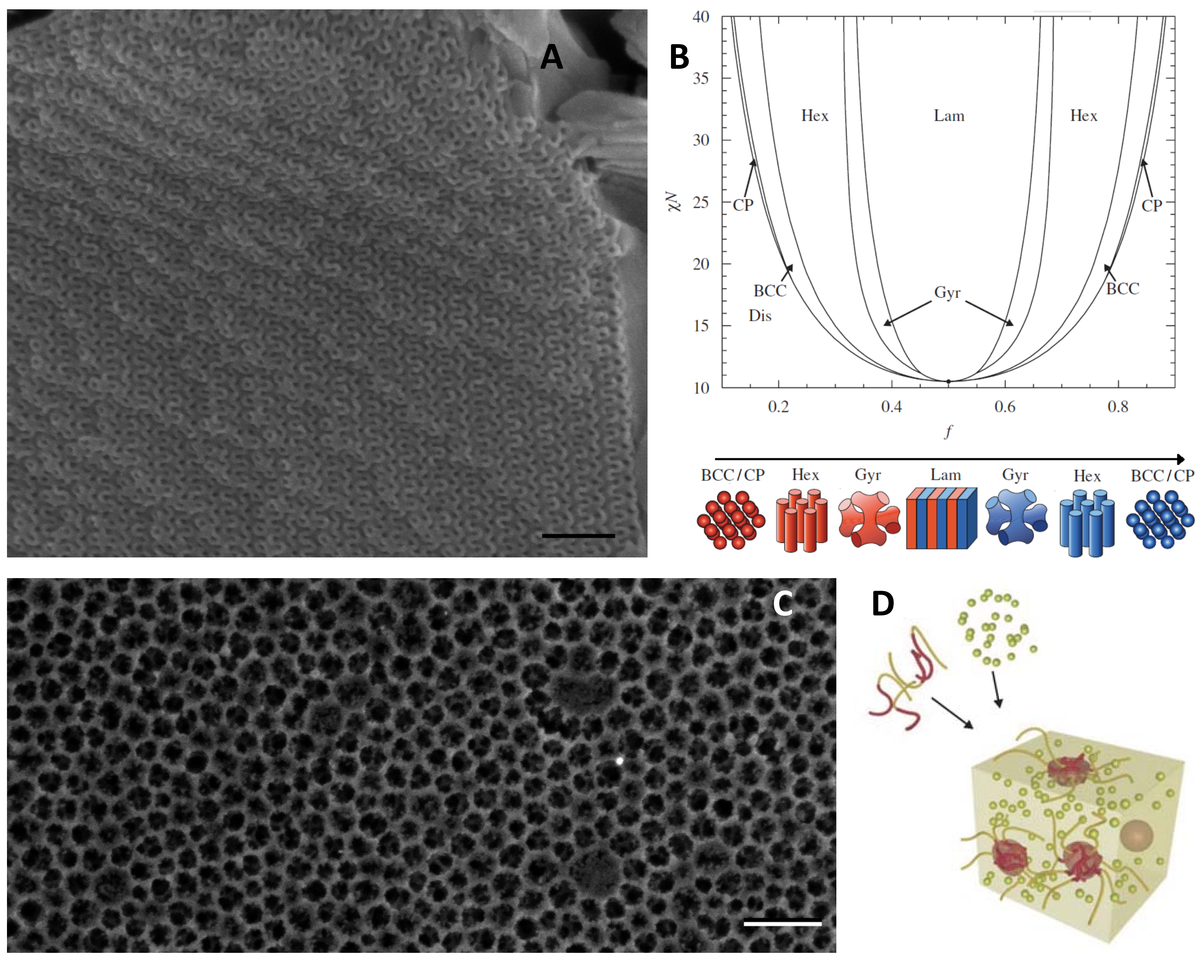


Nanostructuring electrode materials at the 10nm length scale increases the performance of batteries and supercapacitors.

(A) Nanostructured V2O5 cathode (scale bar: 200 nm).
(B) Schematic assembly of a nanostructured supercapacitor or battery.
(C) Energy vs. power density of storage devices. The red circles correspond to a record-breaking supercapacitor based on the material in (A).
(D) Electrochromic response of this device, indicating the polarity of the two sets of electrodes (N,O vs. K, I, A).

D. Wei, M. R. J. Scherer, C. Bower, P. Andrew, T. Ryhänen, U. Steiner, Nano Letters, 2012, 12, 1857–1862.

Block-copolymer directed sol-gel chemistry



Sol-gel chemistry affords the synthesis of various metal oxides and can be directed by block-copolymer self-assembly. The precursor sol complexes with one of the polymer blocks and is compartmentalised by the self-assembly process that sets in during solvent evaporation, leading to a 10nm pore-structure (scale bars: 200 nm).

(A) Gyroid structured TiO2 fabricated by sol-gel chemistry.
(B) Block-copolymer phase diagram. G. M. Grason, Physics Reports, 2006, 433, 1-64.
(C) Inverse micelle TiO2 structure in spin-coated films.
(D) Schematic representation of nano-structure formation during a sol-gel condensation reaction assisted by block-copolymer self-assembly.

Partners and Collaboration

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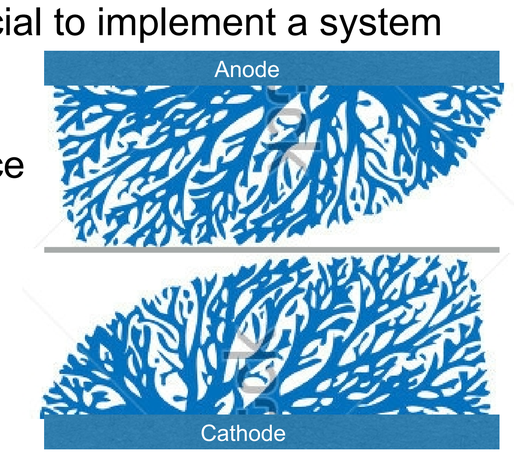
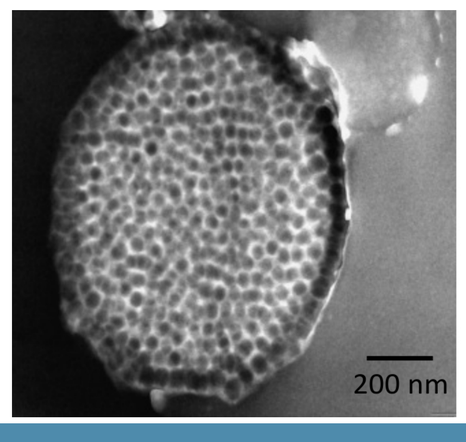
Energy Turnaround

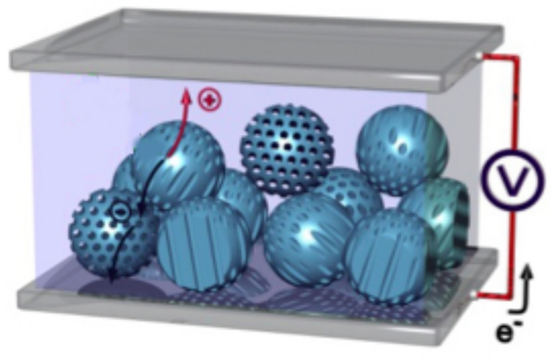
Improving energy storage devices is crucial to implement a system based on renewable energies.

Optimizing the interplay of specific surface area and charge transport in battery electrodes increases performance.

This optimised morphology will then be translated into a scalable methodology.







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