

Redox-Active Porous Organic Materials for Sodium Ion Battery Electrodes: Crystalline Framework Vs. Amorphous Network

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Abstract

Sodium-ion batteries (SIBs) are emerging as an alternative to lithium-ion batteries due to their similar charge-storage mechanism, comparable redox potentials, low cost, and high natural abundance.¹ Traditional anode materials like graphite are not suitable for SIBs due to unfavourable intercalation of Na⁺ ions in graphite.² Flexible design strategy, ease of fabrication, intrinsic porosity, and tunable redox activity of heteroatom-rich porous organic materials make them sustainable alternatives for electrodes in SIBs.³ We developed a redox-active β -ketoenamine-linked covalent organic framework (COF) and its nanocomposite on multiwalled carbon nanotube-based electrodes for Na⁺ ion storage.⁴ The combined effect of improved electrical conductivity and densely populated redox active functional groups in the nanocomposite resulted in a high specific capacity of $567 \pm 10 \text{ mAh g}^{-1}$ at 20 mA g^{-1} with excellent rate performance, of 150 mAh g^{-1} at 2 A g^{-1} . Further, we fabricated a triptycene-based microporous organic ladder polymer for the SIB anode. We found that, compared to crystallinity and surface area, the abundance and accessibility of redox-active functional groups are the most vital factors in developing high-performance organic SIB electrodes. I will present the key aspects of some of these findings.

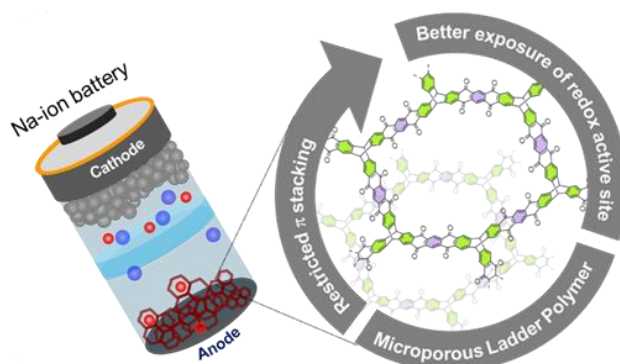


Figure 1 The pictorial depiction illustrating use of porous organic polymers as anode materials for sodium ion battery.

References

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Abhijit Patra received his Ph.D. in 2009 from the University of Hyderabad, working on molecular nano/microcrystals. After postdoctoral research at PPSM, ENS Paris-Saclay on photoswitchable materials, and the University of Wuppertal as an Alexander von Humboldt fellow on conjugated polymer nanoparticles, he started his independent research career at the Indian Institute of Science Education and Research Bhopal in 2012. Currently, he is working as a Professor in the Department of Chemistry, IISER Bhopal. His research interests span various domains and facets of optical materials based on molecular and polymeric assemblies at nano/microscale and porous organic polymers for energy storage and environmental remediation.