Organic materials as polymer electrolytes for supercapacitor application

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18.1 Introduction

Researchers around the world have been attracted to polymer electrolytes (PEs) due to their wide range of possible applications. Research on PEs involves various disciplines such as electrochemistry, macromolecular science, inorganic and organic chemistry. This interest is warranted because PEs have been shown to be conductive materials with advanced functionalities. Historically, PEs were first discovered in the pioneering work of [173], who carried out research on a system based on polyethylene oxide (PEO), which possesses 10^{-8} S cm^{-1} conductivity but at low ambient temperatures [1]. Since the 1980s, work on developing new PEs has undergone much progress and they have become appreciated due to their industrial applications. Tremendous efforts in the last two decades have been dedicated to researching PEs for various applications that can solve many sustainability issues. They are the key components in the development of modern electric devices, including supercapacitors, fuel cells, batteries, sensors, and electrochromic devices. Unlike other materials used for similar purposes, PEs exhibit mechanical flexibility and conductive properties while in the solid state. Thus PEs are regarded as ideal replacements for liquid electrolytes (LEs) due to no internal shorting, lower flammability, and no solvent evaporation or leakage [2]. Additionally, PEs has been widely used due to several native advantages:

- It possesses a heteroatom, such as oxygen (O), nitrogen (N), and sulfur (S), that bears lone electron pairs with enough donor power to complex with cations.
- It can facilitate ionic contact at the interface of electrode–electrolyte; thus the circuit can be closed when the cell is being used.
- It ensures that the positive and negative electrodes are separated electronically and spatially so that no short-circuits or self-discharging of the cell can occur. This ability can be very remarkable in some situations.
- It possesses coordinating centers that are sufficiently far apart to promote the hopping of charge carriers.
- Its polymer chain segments possess enough flexibility that can promote the movement of ionic carriers.

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