# Off-Planar, Two-Dimensional Polymer Cathode for High-Rate, Durable Rechargeable Magnesium Batteries

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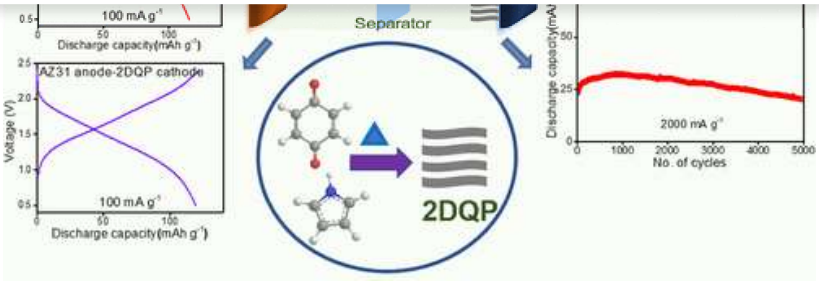
**SUBJECTS:** Batteries, Electrical properties, Electrodes, Magnesium, Polymers

## Abstract




Rechargeable magnesium batteries are of considerable interest due to their high theoretical capacity, and they are projected as good alternates for stationary energy storage and electric vehicles. Sluggish $Mg^{2+}$ kinetics and scarce availability of suitable cathode materials are major issues hindering the progress of rechargeable magnesium batteries. Herein, a conjugated, off-planar, two-dimensional (2D) polymer is explored for reversible magnesium storage. The polymer cathode reveals high capacity and high cycling stability with high rate capability. Replacing the Mg metal anode with the Mg alloy, AZ31 further enhances the ion storage performance. At a high current density of 2 A $g^{-1}$, stable capacity is shown for almost 5000 cycles with 99% Coulombic efficiency. A composite of carbon nanotube with the polymer delivers capacity values higher (>1.5 times) than that of a pristine polymer at a current density of 2 A $g^{-1}$ and shows cycling up to 5 A $g^{-1}$. Electrokinetic studies reveal a contribution of pseudocapacitive nature, and the mechanism is investigated by ex situ X-ray photoelectron spectroscopy and infrared spectroscopy. The use of 2D polymer electrodes opens up opportunities for developing high-rate, high-capacity, and stable rechargeable magnesium ion batteries.

**KEYWORDS:** magnesium storage, conjugated polymer, magnesium alloy, anode interface, carbon composite