

青年园地

## 金属氮化物纳米储能材料及其 柔性超级电容器

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**摘 要:** 超级电容器具有功率密度高、循环寿命长和安全性高等优点, 在储能领域具有巨大的应用前景。如何设计和制备具有优异电容性能的电极材料和电极结构是制备高性能超级电容器的关键。过渡金属氮化物( $M_xN$ ,  $M=Ti, V, Mo, Nb, W$ )是一类具有开发潜力的优异电化学储能材料。相比碳材料, 过渡金属氮化物具有更大的比电容, 相比过渡金属氧化物电极材料, 过渡金属氮化物表现出更为优异的倍率性能和快速充放电性能。介绍了几种典型的过渡金属氮化物储能材料及其电容特性, 利用金属氮化物纳米线高长径比的特征, 通过简单真空抽滤的方法, 制备了具有良好机械柔性的三维交织的纳米线基薄膜纸电极; 结合凝胶电解液, 构建了高性能的柔性全固态超级电容器, 最后对过渡金属氮化物在超级电容器领域的发展进行了展望。

**关键词:** 超级电容器; 电极材料; 过渡金属氮化物; 复合材料; 柔性电极; 全固态器件; 储能性能

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## Flexible Supercapacitors Based on Transitional Metal Nitride Nanostructures

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**Abstract:** With growing concerns over fossil energy and ever-increasing environmental pollution, there is a strong and growing demand for the development of efficient energy-storage systems for applications in portable electric devices, smart grids and electric vehicles (EVs). Supercapacitor (SC), an emerging energy storage device that bridges the gap between conventional capacitors and rechargeable batteries, has attracted increasing attention due to its large power density, long-term operation stability as well as high safety. Electrode materials are the key components of SCs, largely determining the device performance. Transitional metal nitrides (TMNs,  $M=Ti, V, Mo, Nb, W$ ) are promising

electrochemical electrode materials for SCs due to high conductivity and large specific capacitance. Compared to carbon electrodes such as carbon nanotube, graphene and active carbon, metal nitrides exhibit higher specific capacitance, especially much higher volumetric capacitance. Additionally, because of high conductivity like metal, transitional metal nitrides exhibit super rate performance and higher power density at high current density compared to

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