NbB_2 as a promising electrode material for supercapacitors with high electrochemical performance

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The primary limitation in producing supercapacitors compared to batteries is their low energy densities. In recent years, big efforts have been made to increase energy densities to levels reached in batteries without losing their power densities. In the face of this challenge, the development of high-performance electrode materials is of significant importance [1,2]. As an electrode material, transition metal borides have been a possible choice for supercapacitors due to their excellent electrochemical properties, including high specific capacitance, great electrical conductivity, and good cycling loop retention [3]. They are also known for their strong chemical stability, abundance of electroactive sites, and shorter path lengths for ion diffusion. 2D boron-based materials such as Borophene and MBenes have also attracted attention as electrode materials in recent years [4,5].

In this work, the potential of NbB_2 which belongs to a group of transition metal borides as a novel, high-performance electrode material for supercapacitors, was investigated. NbB_2 powders were successfully prepared by a molten-salt assisted borothermal reduction method using Nb powder and amorphous B powder as starting materials at 850°C for 4h in N_2 atmosphere. Phase transformation was studied by XRD and morphology of materials was studied by SEM and TEM analysis. The results showed that NbB_2 was successfully synthesized in the presence of molten LiCl/KCl salts at lower temperatures and higher yields. When applied to a supercapacitor, the NbB_2 displayed a specific capacitance of 102 F/g at 1 A/g in the three-electrode system in 1 M Na_2SO_4 electrolyte. These findings indicate that NbB_2 has a strong potential as electrode material for supercapacitors.

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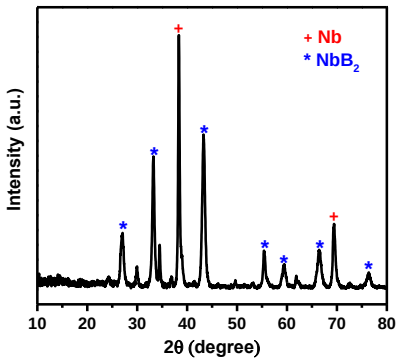

Fig. 1. XRD spectra of NbB_2.

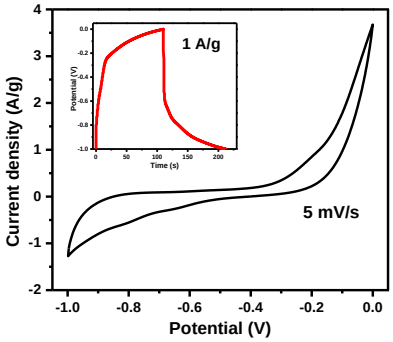

Fig. 2. CV and GCD (inset) curve of NbB_2.

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