chem2Dmat
August 31 - September 03, 2021 ● Bologna, Italy
European Conference on Chemistry of Two-Dimensional Materials

2D layered $CrPSe_3$-G-MWCNTs@NiB composite as a superior anode for high performance lithium storage

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Abstract
Energy storage based on electrochemical systems has made a surprising contribution to the well-being of our modern society. In particular, with the development of the electric vehicles (EVs) and storage energy stations, lithium-ion batteries (LIBs) due to their advantageous energy storage performance, low weight, and versatility not only have been given an excellent development opportunity but also have encountered a great challenge due to the huge demands of key markets, such as higher capacity [1]. Accordingly, the key solution to these issues is dependent upon the development of the new electrode materials with high energy and power densities [2]. Based on the considerations of attractive Li storage properties of two-dimensional (2D) layered chromium selenophosphate ($CrPSe_3$), as well as high conductivity and high specific surface area of carbon materials (graphite and multi-walled carbon nanotubes), we synthesized a 2D $CrPSe_3$ by one step high-temperature solid-phase synthesis [3]. After combining with graphite (G) and multi-walled carbon nanotubes (MWCNTs) by high-energy ball milling, the novel 2D/2D heterojunction of $CrPSe_3$-G-MWCNTs@NiB composite was successfully prepared. The XRD data of bulk $CrPSe_3$, $CrPSe_3$-G-MWCNTs, and $CrPSe_3$-G-MWCNTs@NiB materials are displayed in **Figure 1**, which exhibit similar diffraction peaks that can be well assigned to the $CrPSe_3$ phase (PDF no. 00-033-0403). Compared with the pristine $CrPSe_3$, the introduction of carbon materials can enhance its electronic conductivity, increase the interface contact area, and ameliorate the volume change during the repeated insertion/extraction of Li, thus contributing to fast ion/electron transport kinetics [4]. Following this trend, promising electrochemical performances in terms of low discharge-charge polarization, reversibility, cycling stability (660 mAh g^{-1} after 70 cycles), and capacity retention (89%) are observed (**Figure 2**). Thus, such a kind of 2D layered $CrPSe_3$-G-MWCNTs@NiB material is considered as a promising anode for high performance LIBs.

References

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Figures

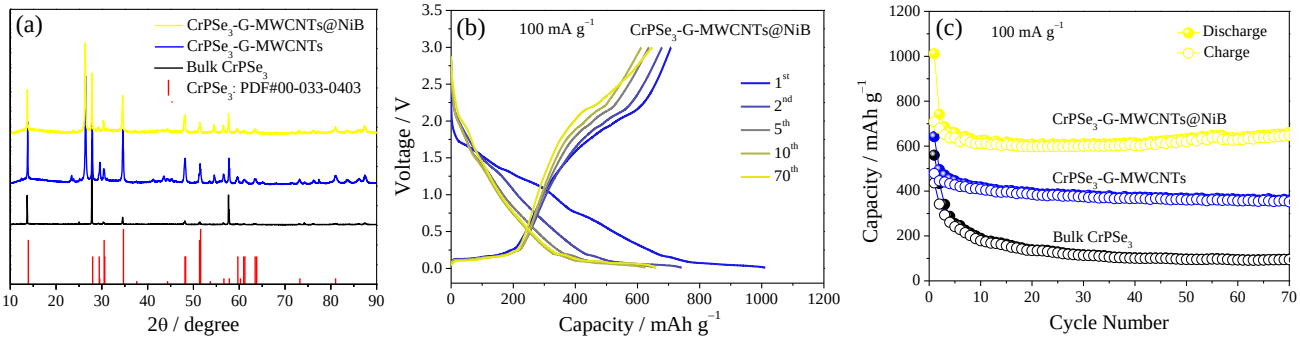

Figure 1: (a) XRD patterns of bulk $CrPSe_3$, $CrPSe_3$-G-MWCNTs, and $CrPSe_3$-G-MWCNTs@NiB composites; Cycling response of (b, c) bulk $CrPSe_3$, $CrPSe_3$-G-MWCNTs, and $CrPSe_3$-G-MWCNTs@NiB in two-electrode half-cell at 100 mA g^{-1} current density in terms of (b) voltage profiles of selected cycles and (c) cycling trend.