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# Robust Graphene Layer Modified Na<sub>2</sub>MnP<sub>2</sub>O<sub>7</sub> as a Durable High-Rate and High Energy Cathode for Na-ion Batteries

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## Abstract

Na<sub>2</sub>MnP<sub>2</sub>O<sub>7</sub> has been considered as a promising cathode candidate for advanced sodium-ion batteries due to its high potential, low cost and non-toxicity. However, the low initial Coulombic efficiency, poor high-rate and unsatisfactory cycling ability originated from the intrinsic inferior electronic conductivity and manganese dissolution severely hinder its practical application. Herein, we report an approach based on a feasible high energy vibrating activation process to fabricate a robust graphene layers (GL) modified Na<sub>2</sub>MnP<sub>2</sub>O<sub>7</sub> material (noted as NMP@GL) for the first time. The as-prepared NMP@GL could exhibit an ultrahigh initial Coulombic efficiency of 90%, and a high energy density over 300 Wh kg<sup>-1</sup>. In addition, rate performance and cycling

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