

## Accepted Manuscript

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PII: S1385-8947(18)30892-1  
DOI: <https://doi.org/10.1016/j.cej.2018.05.078>  
Reference: CEJ 19094

To appear in: *Chemical Engineering Journal*

Received Date: 24 February 2018  
Revised Date: 25 April 2018  
Accepted Date: 11 May 2018

Please cite this article as: T. Huang, D. Lu, L. Ma, X. Xi, R. Liu, D. Wu, iA Hit-and-Run Strategy towards Perylene Diimide/Reduced Graphene Oxide as High Performance Sodium Ion Battery Cathode, *Chemical Engineering Journal* (2018), doi: <https://doi.org/10.1016/j.cej.2018.05.078>

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## A Hit-and-Run Strategy towards Perylene Diimide/Reduced Graphene Oxide as High Performance Sodium Ion Battery Cathode

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**Abstract:** A composite of perylene diimide/reduced graphene oxide (PDI/RGO) is fabricated via a hit-and-run strategy in this work. In the hitting step, the ionic self-assembly of positively charged N,N'-bis(N-ethyl-N,N-dimethylhexan-1-aminium)perylene-3,4,9,10-tetracarboxylic diimide bromide (N<sup>+</sup>-PDI) and negative charged graphene oxide (GO) leads to the formation of the highly wrinkled composites (N<sup>+</sup>-PDI/RGOs) in solution. In the following running step to generate PDI/RGO, the composite of N<sup>+</sup>-PDI and solvothermally reduced GO is thermally treated at 300 °C to remove the ammonium groups in N<sup>+</sup>-PDI and further improve the conductivity. As the cathode in sodium ion battery (SIB), PDI/RGO delivers a specific capacity of ~175 mA h g<sup>-1</sup> at 50 mA g<sup>-1</sup> even after 500 charge-discharge cycles and still maintains a capacity of ~73 mA h g<sup>-1</sup> at 800 mA g<sup>-1</sup>, outperforming most of the state-of-art organic SIB cathodes. More importantly, the investigation on the changes of the composites during the fabrication processes enables the understanding of the influences of the morphology, crystallinity, and compositions on their electrochemical performances in SIB, which will be helpful for the design of high performance organic electrodes in secondary batteries.

**Keywords:** perylene diimide, reduced graphene oxide, organic cathode, sodium ion battery

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