Two Dimensional WS_2/C Nanosheets as a Polysulphide immobilizer for High Performance Lithium-Sulphur Batteries

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With the rapid advancement in portable electronic devices and electric vehicles, the demand for advanced research on next generation high energy density lithium ion batteries has gained significant importance. Among the different alternatives proposed to succeed lithium ion batteries, lithium sulphur batteries have drawn most attention because of the ultrahigh theoretical specific capacity(1675mAh/g) and specific energy density(2600Wh/kg) [1]. Despite the tremendous potential, lithium sulphur batteries suffers from some major challenges which include rapid capacity fade and poor high rate performance originating from the "shuttling effect" of the electrolyte soluble polysulphide intermediates, low electronic conductivity of sulphur (5 X 10^{-30} S/cm) and high volumetric change (80%) of sulphur during charge/discharge process, resulting in pulverization and loss of electrical contact from the current collector [1]. In the present work, we have utilized a straightforward one-step solid phase synthesis strategy to prepare WS_2 nanosheets anchored on carbon nanosheets networks. The WS_2 nanosheets will provide anchoring sites for lithium polysulphide intermediates leading to superior cycling performance and significantly enhanced rate capability. Electrochemical testing of WS_2/C nanosheets composite showed improved cycling and rate performance by delivering specific discharge capacity of around 729mAh/g, 693mAh/g, 535mAh/g and 512mAh/g at 1C, 2C, 4C and 8C with capacity retention of 70% (0.060% decay/cycle), 81% (0.039% decay/cycle), 69% (0.063% decay/cycle) and 80% (0.040% decay/cycle) respectively, after 500 cycles as shown in the figure. This work demonstrates the use of flexible 2D materials beyond graphene for high performance lithium sulphur batteries.

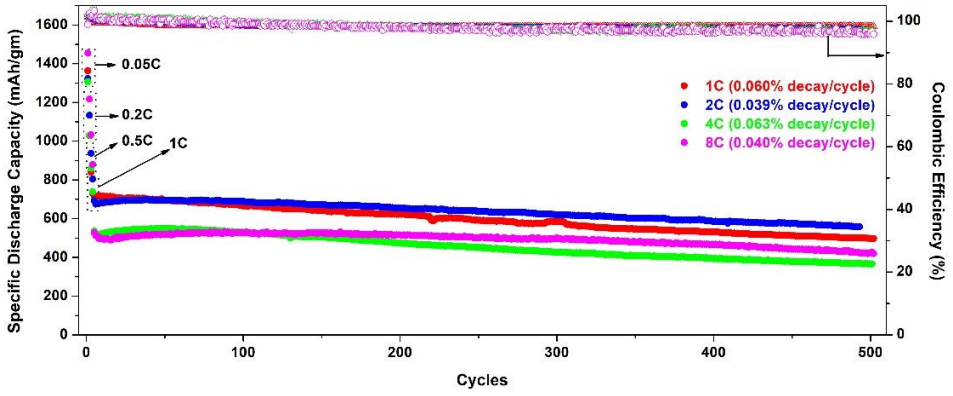

Fig: Cycling performance at 1C, 2C, 4C and 8C rates respectively.

References:

[1] H. Yu, H. Li, S. Yuan, Y. Yang, J. Zheng, J. Hu, D. Yang, Y. Wang, A. Dong, Nano Res.10(2017) 2495-2507.