# High Energy Supercapacitors based on Vanadium Chalcogenides-RGO/CNTs Hybrids

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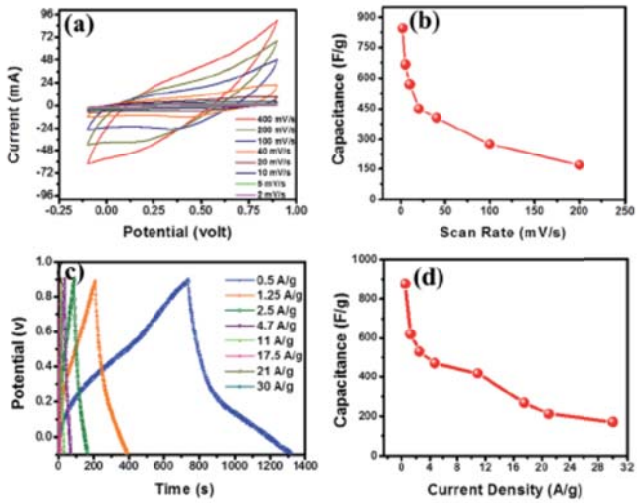
**Abstract:**
Facile hydrothermal synthesis and detailed study on supercapacitor applications of a patronite hybrid, VS4/reduced graphene oxide, $VS_4$/single-walled carbon nanotubes/reduced graphene oxide and $VSe_2$ –reduced grapheme oxide (RGO) will be presented. Patronite hybrid, VS4/reduced graphene oxide, which showed an enhanced specific capacitance of ~877 F/g at a current density of 0.5 A/g.[1] In comparison to bare vanadium sulfide and reduced graphene oxide, the hybrid showed ~6 times and ~5 times higher value of specific capacitance, respectively. The obtained energy density (117 W h/kg) and power density (20.65 kW/kg) are comparable to those of other reported transition metal sulfides and their graphene hybrids.[2] Detailed electrochemical investigations of $VS_4$/single-walled carbon nanotubes/reduced graphene oxide showed an exceptionally high energy density of the hybrid which was of the order of ~174 W h/Kg.[3] The value was compared to other supercapacitor electrodes based on metal sulphides and also some of those having reportedly high energy density values. The comparison reveals the potential of the patronite hybrid to be a fitting candidate for its possible application in energy storage devices. $VSe_2$-RGO shows specific capacitance of ~680 F/g, a high energy density of ~212 W h/Kg and power density of 33 kW/kg.[4] The charge-discharge stability measurements show excellent specific capacitance with the retention capability of ~97 % after 1000 continuous charge-discharge cycles for $VS_2$-RGO and retention capability of ~81 % even after 10, 000 charge-discharge cycles. The results infer that the hybrids have the potential to be used as a high performance supercapacitor electrode.




## References:

1. S. Ratha, S. R. Marri,N. A. Lanzillo, S. Moshkalev, S. K. Nayak, J. N. Behera, C. S. Rout, *J. Mater. Chem. A*, **2015**, *3*, 18874.
2. J. Feng, X. Sun, C. Wu, L. Peng, C. Lin, S. Hu, J. Yang and Y. Xie, *J. Am. Chem. Soc*., **2011**, *133*, 17832.
3. S. Rath, S. R. Marri, J. N. Behera and C. S. Rout, *Eur J. Inorg. Chem*., **2016**, 259.
4. S. R. Marri, S. Rath, C. S. Rout, J. N. Behera, *Chem Commun*., **2017**, 53, 228.