Supporting Information

Enhanced capacitor effects in polyoxometalate/grapheme nanohybrid materials; a synergetic approach to high performance energy storages

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Characterization of the POM/RGOnanohybrid materials

Figure S2 shows the IR spectra of RGO, $TBA_3[PMo_{12}O_{40}]$, and the POM/RGO hybrid. They indicate the presence of the $[PMo_{12}O_{40}]^{3-}$ anion in the POM/RGO hybrid material with little structural change from that in $TBA_3[PMo_{12}O_{40}]$. The resonant Raman spectra of the as-prepared RGO and the POM/RGO hybrid were measured at the excitation wavelength of 514 nm (see Fig. S3). These two samples exhibit the G (1583 cm^{-1}) and D (1348 cm^{-1}) bands, which are assignable to the first-order scattering of the E_{2g} vibration mode for the sp^2 domains of graphene and the breathing mode of the *k*-point phonons of A_{1g} symmetry, respectively.[S1] The intensity ratio of the D and G bands, which is known to reflect the degree of disorder and the average size of the sp^2 domains,[S1] is 1.4 or 1.0 for RGO or POM/RGO, respectively. This small difference between the two values means that the nanohybridization does not bring about a significant change in the sp^2 domains of graphenes.

References

S1. (a)A. C. Ferrari, J. C. Meyer, V. C. Scardaci, C. M. Lazzeri, F. Mauri, S. Piscanec, D. Jiang, K. S. Novoselov, S. Roth, A. K. Geim, *Phys. Rev. Lett*. 2006, **97**, 187401, (b)A. C. Ferrari, *Solid State Commun.*, 2007, **143**, 47.

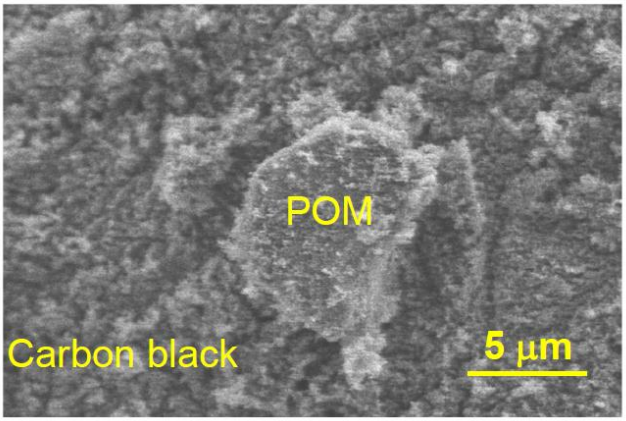

Figure S1. SEM image of cathode materials in POM-MCB.

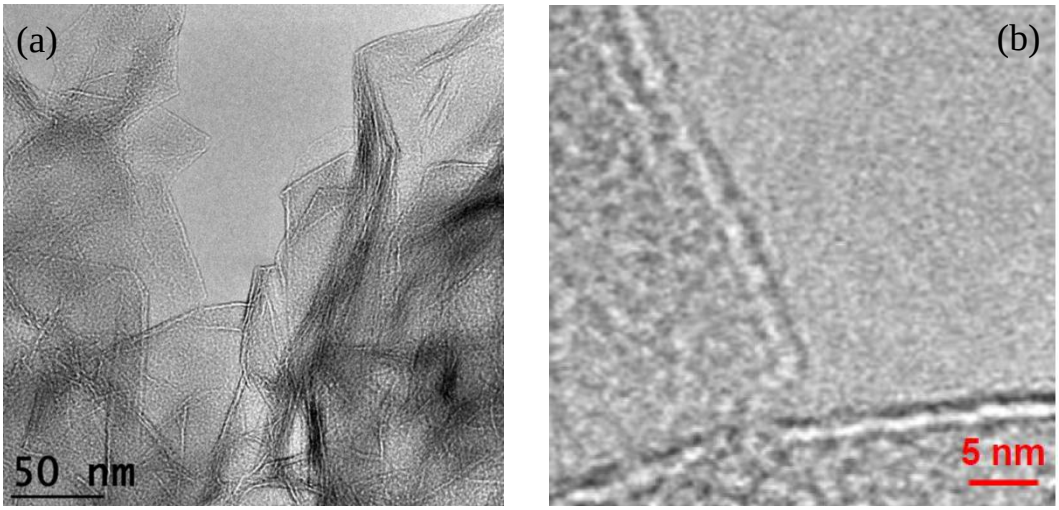

Figure S2. (a) TEM image of RGO, (b) Magnified TEM image of RGO

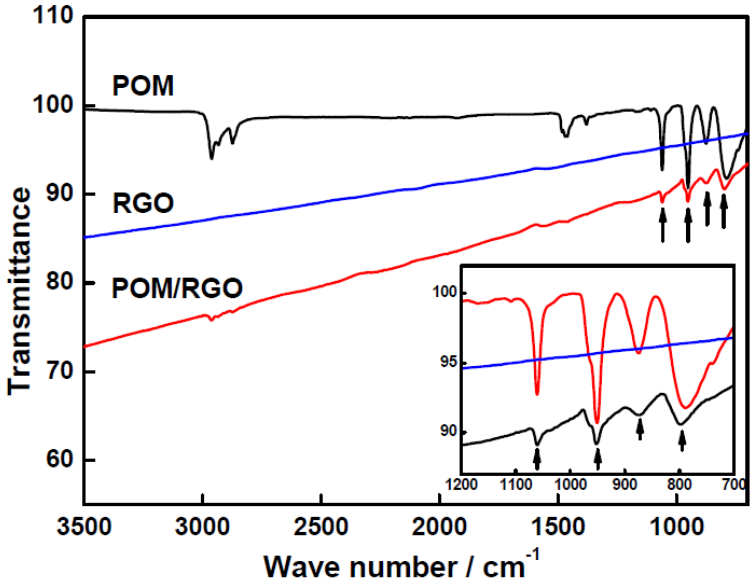

Figure S3.IR spectra of the POM, RGO, and POM/RGO hybrid materials.The inset is a magnification for the range of 1200-7000 cm^{-1}. Arrows indicate peaks assigned to POMs.

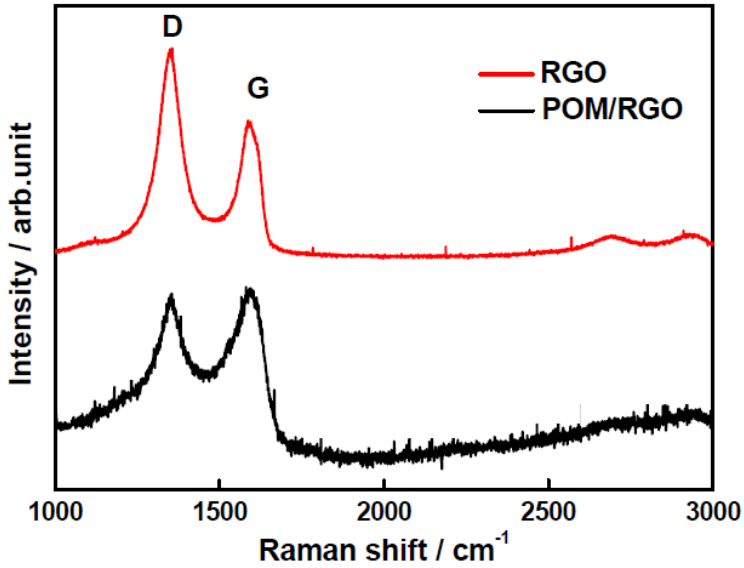

Figure S4.Raman spectra of the as-prepared RGOs and POM/RGO hybrid materials.

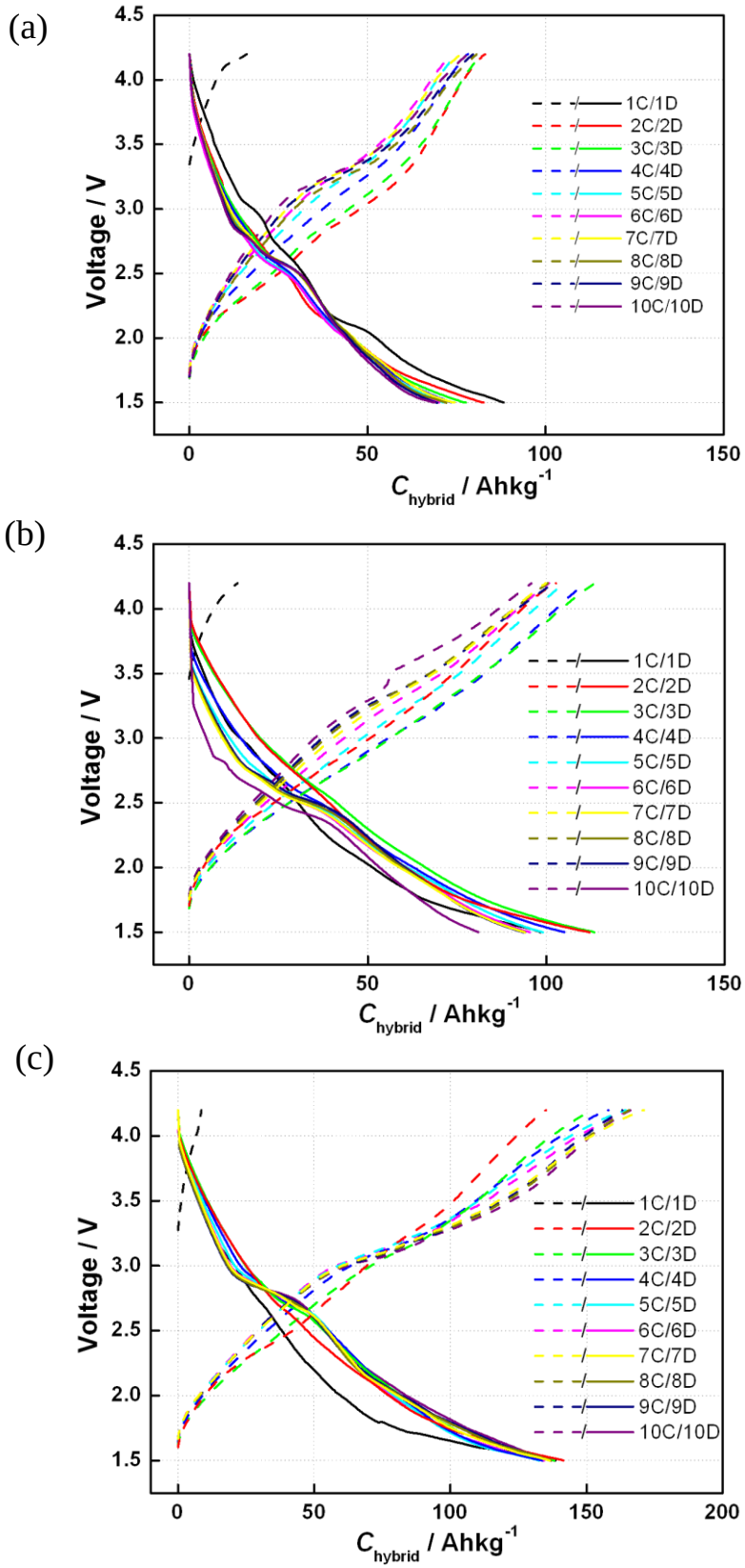

Figure S5. First ten cycle charge/discharge curves of POM/RGOhybrid (a), POM/SWNT hybrid (b),andmicrocrystal-POM MCBs (c).

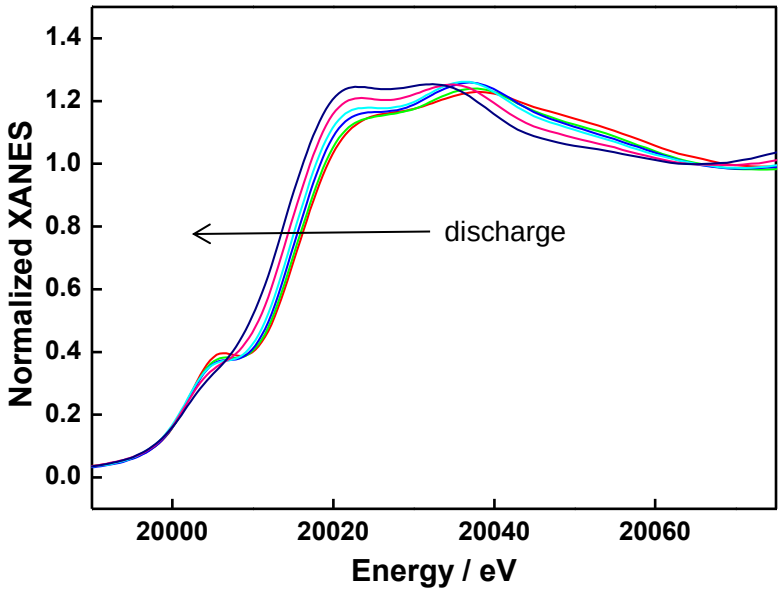

Figure S6.Operando Mo *K*-edge XANES spectra for the POM/RGO MCBs in the first discharge process.

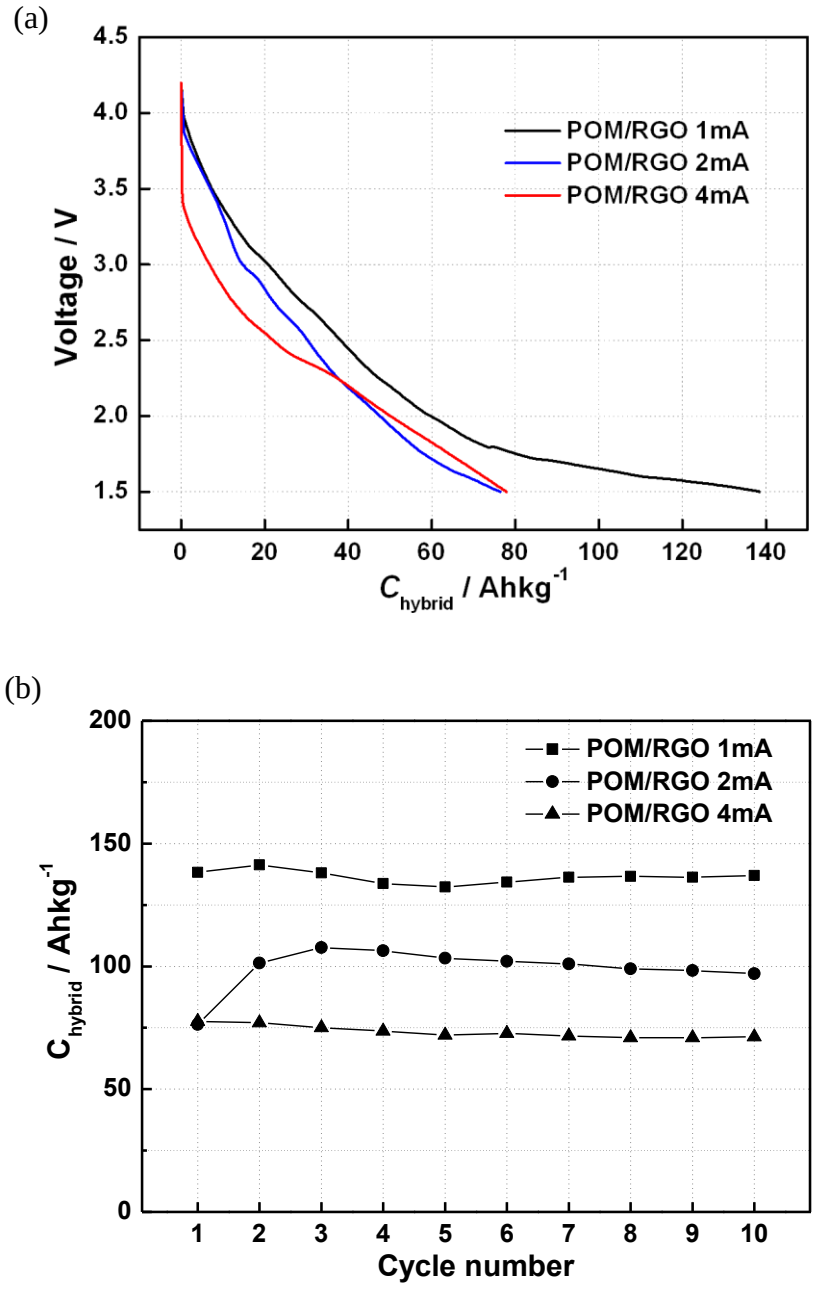

Figure S7.(a) 1st discharge curves and (b) cycle performances of the POM/RGO MCBs at 1, 2 and 4 mA.

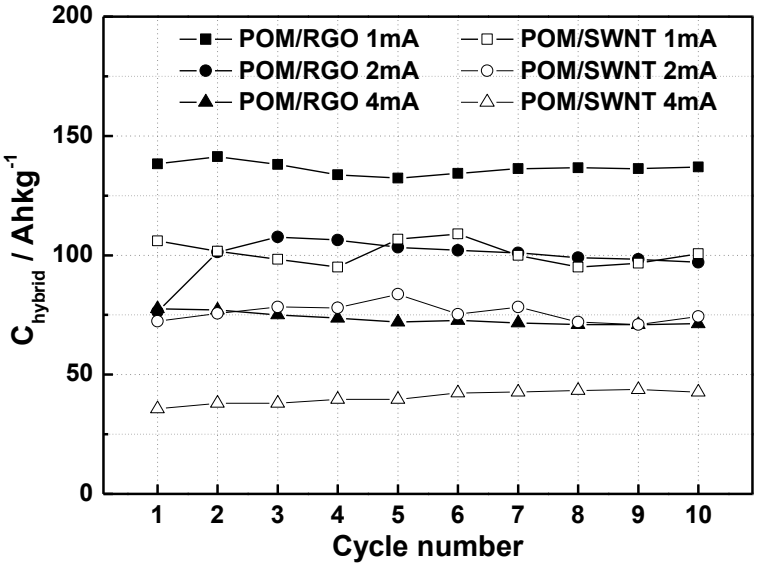

Figure S8.(a) 1st discharge curves and (b) cycle performances of the POM/RGO and the POM/SWNT hybrid MCBs at 1, 2 and 4 mA.

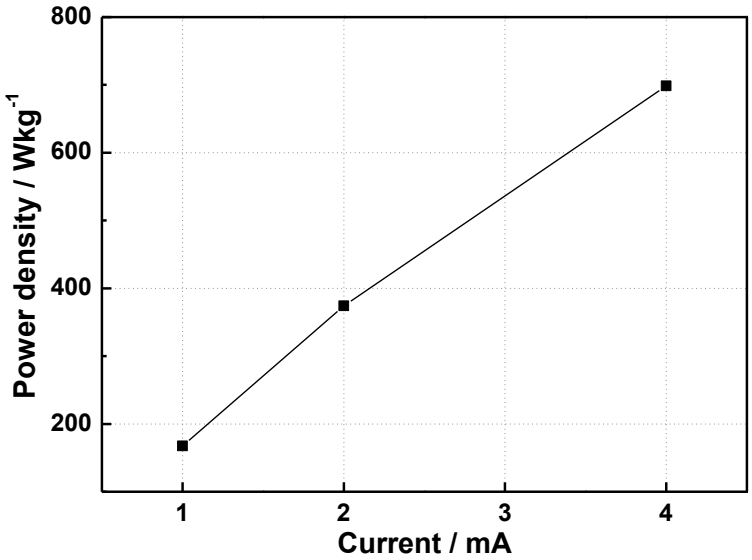

Figure S9.Power density plots for the POM/RGO MCBs at 1, 2 and 4 mA.