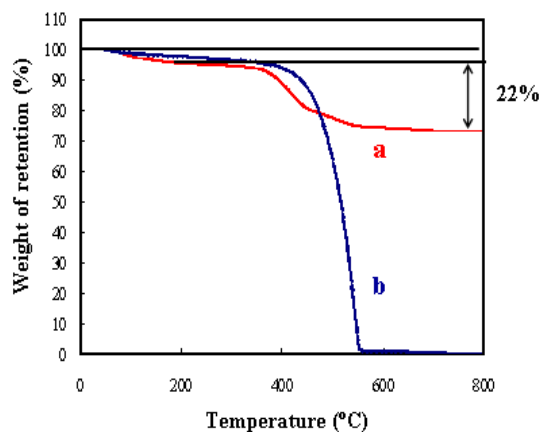**Supporting Information**

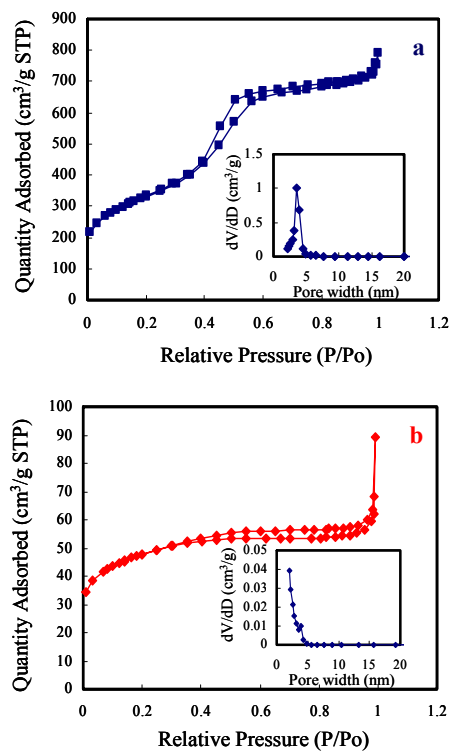**Fig. S1** TGA curves of (a) ZnV_2O_4-CMK nanocomposites and (b) mesoporous carbon CMK.

Fig. S2 N_2 adsorption-desorption isotherms of (a) the ordered mesoporous carbon CMK and (b) ZnV_2O_4-CMK nanocomposites. Inset: pore size distributions from the desorption branch through the BJH method.

According to the approach proposed by Huggins et al, the apparent diffusion coefficient of Li^+ in electrode material, D_{Li}, can be calculated by the following equ. (1) [S1, S2]:

$$D_{Li} = \frac{1}{2}[(\frac{V_m}{FAS})(\frac{\partial E}{\partial X})]^2 \qquad (1)$$

where V_m is the electrode material molar volume; F is the Faraday constant; A is a constant which contains a concentration independent diffusion coefficient, which can be obtained from the diffusion impedance ($Z_w* = A \ \omega^{-1/2} - jA \ \omega^{-1/2}$) (see Fig. S3); S is the effective electrode surface area; $\frac{\partial E}{\partial X}$ is the voltage change upon discharging.

The relationship between Z_{re} and $\omega^{-0.5}$ in the low frequency region is shown in Fig. S3. The Warburg factors are 13.5 for ZnV$_2$O$_4$-CMK nanocomposites (A_a) and 38.5 for bulk ZnV$_2$O$_4$ (A_b), respectively. The value of A_b is 2.8 times as large as that of A_a.
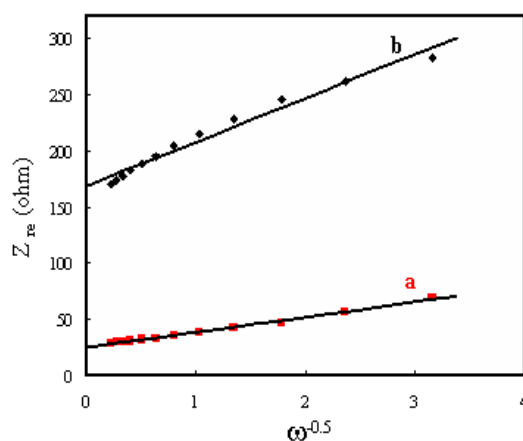

Fig. S3 The relationship between Z_{re} and $\omega^{-0.5}$ for (a) ZnV$_2$O$_4$-CMK nanocomposites and (b) bulk ZnV$_2$O$_4$.

If D_{Li} in the anode of ZnV$_2$O$_4$-CMK nanocomposites is same as that of the bulk ZnV$_2$O$_4$, the ratio of the effective surface area between the ZnV$_2$O$_4$-CMK nanocomposites and the bulk ZnV$_2$O$_4$ can be expressed as the following equ (2)

$$n = \frac{S_a}{S_b} = \frac{(\frac{\partial E}{\partial X})_a A_b}{(\frac{\partial E}{\partial X})_b A_a} \qquad (2)$$

which results in n=2.8, indicating 2.8 times as high as effective electrode surface area of the ZnV_2O_4-CMK nanocomposites compared to that of the bulk ZnV_2O_4.   A low charge-transfer resistance and high effective surface of the electrode are favored for electron and Li^+ transport in ZnV_2O_4-CMK nanocomposites.

On the other hand, the diffusion coefficient of Li^+ can be calculated from the plots in the low-frequency region according to the following equs [S3, S4]:

$$D = \frac{R^2T^2}{2A^2n^2F^4C^2\sigma^2}$$ (3)

$$Zre = R_{ct} + R_e + \sigma_w\omega^{-0.5}$$ (4)

where R is the gas constant, T is the room temperature in our experiment, n is the number of electron per molecule oxidized, A is the surface area, F is Faraday's constant, C is the concentration, D is the diffusion coefficient, and σ is the Warburg factor.

The Warburg factors σ are 13.5 for ZnV_2O_4-CMK nanocomposites (σ_a) and 38.5 for bulk ZnV_2O_4 (σ_b), respectively.   The value of σ_b is 2.8 times as large as that of σ_a.   If other parameters are fixed, the diffusion coefficient of ZnV_2O_4-CMK nanocomposites is larger than that of bulk ZnV_2O_4.   The electronic conductivity of ZnV_2O_4-CMK sample was enhanced due to the good electrical conductivity of CMK in the nanocomposites, where they served as both an active material and a conductor in the anode.   Thus, the cycle performance of ZnV_2O_4-CMK nanocomposites can be improved significantly.

In fact, the results of EIS simulation analysis which carried out by two models mentioned above are all consistent with our experimental results.

Refs.

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