Supporting Information

**Fig. S1** TGA curves of (a) ZnV$_2$O$_4$-CMK nanocomposites and (b) mesoporous carbon CMK.

**Fig. S2** N$_2$ adsorption-desorption isotherms of (a) the ordered mesoporous carbon CMK and (b) ZnV$_2$O$_4$-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)\(^{[1,2]}\):

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

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 Zn\(V_2O_4\)-CMK nanocomposites \((A_a)\) and 38.5 for bulk Zn\(V_2O_4\) \((A_b)\), respectively. The value of \(A_b\) is 2.8 times as large as that of \(A_a\).

![Fig. S3](image)

**Fig. S3** The relationship between \(Z_{re}\) and \(\omega^{-0.5}\) for (a) Zn\(V_2O_4\)-CMK nanocomposites and (b) bulk Zn\(V_2O_4\).

If \(D_{Li}\) in the anode of Zn\(V_2O_4\)-CMK nanocomposites is same as that of the bulk Zn\(V_2O_4\), the ratio of the effective surface area between the Zn\(V_2O_4\)-CMK nanocomposites and the bulk Zn\(V_2O_4\) can be expressed as the following equ (2)

\[
n = \frac{S_a}{S_b} = \left( \frac{\partial E}{\partial X} \right)_a \frac{A_b}{\left( \frac{\partial E}{\partial X} \right)_b A_a}
\]

\[(2)\]

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which results in $n=2.8$, indicating 2.8 times as high as effective electrode surface area of the ZnV$_2$O$_4$-CMK nanocomposites compared to that of the bulk ZnV$_2$O$_4$. A low charge-transfer resistance and high effective surface of the electrode are favored for electron and Li$^+$ transport in ZnV$_2$O$_4$-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 equa\textsuperscript{[S3, S4]}:

\begin{align}
D &= \frac{R^2T^2}{2A^2n\bar{F}C^2\sigma^2} \quad (3) \\
Z\text{re} &= R_{ct} + R_e + \sigma_w \omega^{0.5} \quad (4)
\end{align}

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 $\sigma$ is the Warburg factor.

The Warburg factors $\sigma$ are 13.5 for ZnV$_2$O$_4$-CMK nanocomposites ($\sigma_a$) and 38.5 for bulk ZnV$_2$O$_4$ ($\sigma_b$), respectively. The value of $\sigma_b$ is 2.8 times as large as that of $\sigma_a$. If other parameters are fixed, the diffusion coefficient of ZnV$_2$O$_4$-CMK nanocomposites is larger than that of bulk ZnV$_2$O$_4$. The electronic conductivity of ZnV$_2$O$_4$-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$_2$O$_4$-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.

\textbf{Refs.}


