Supporting Information

Nitrogen doped intercalation TiO$_2$/TiN/Ti$_3$C$_2$Tx nanocomposite electrodes with enhanced pseudocapacitance

Ben Yang $^{1}$, Yin She $^{1,2,*}$, Changgeng Zhang $^{1}$, Shuai Kang $^{3}$, Jin Zhou $^{4}$, Wei Hu $^{3,*}$

$^{1}$ Key Laboratory of Optoelectronic Technology and System of Ministry of Education, College of Optoelectronic Engineering, Chongqing University, Chongqing 400044, China; 201908021058@cqu.edu.cn (B. Y.); sheyin@cqu.edu.cn (Y. S.); SillerZ@cqu.edu.cn (C. Z.); weihu@cqu.edu.cn (W. H.)

$^{2}$ Key Laboratory of Fundamental Science Micro/Nano Device System Technology, Micro System Research Center of Chongqing University, Chongqing 400044, China

$^{3}$ Intelligent Manufacturing Technology Institute, Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences, Chongqing 400714, China; Kangshuai@cigit.ac.cn (S. K.)

$^{4}$ Chongqing Academy of Metrology and Quality Inspection, Chongqing 401121, China; zhoujin1203@163.com (J. Z)

* Correspondence: sheyin@cqu.edu.cn; Tel.: +86-18602361894; weihu@cqu.edu.cn; Tel.: +86-13896111800
Figure S1. XRD patterns of Ti₃C₂Tx and 6 h, 12 h, 20 h N-TiO₂/TiN/Ti₃C₂Tx.

Figure S2. High-magnification SEM images of pristine Ti₃AlC₂.

Figure S3. CV curves at scan rate of 50 mV s⁻¹ of conductive carbon paper.
Figure S4. CV and GCD curves of Ti₃C₂Tx in different electrolytes of (a-b) Na₂SO₄, (c-d) Li₂SO₄, (e-f) KOH and (g-h) LiOH.
Figure S5. CV and GCD curves of 20 h N-TiO$_2$/TiN/Ti:C:T$_x$ in different electrolytes of (a-b) Na$_2$SO$_4$, (c-d) Li$_2$SO$_4$, (e-f) KOH and (g-h) LiOH.
Figure S6. CV and GCD curves of (a-b) 6 h, (c-d) 12 h N-TiO$_2$/TiN/Ti$_3$C$_2$T$_x$ in H$_2$SO$_4$ electrolyte.

Figure S7. Nyquist plots of 20 h N-TiO$_2$/TiN/Ti$_3$C$_2$T$_x$ in different electrolytes. 1M H$_2$SO$_4$ have lower resistance of the bulk electrolyte solution compared with Na$_2$SO$_4$, Li$_2$SO$_4$, KOH and LiOH.
Figure S8. GCD plots at different current densities of the symmetric 20 h N-TiO$_2$/TiN/Ti:C:Tx/20 h N-TiO$_2$/TiN/Ti:C:Tx supercapacitor in 1 M H$_2$SO$_4$. 
Calculation of specific capacitance

CV tests

The specific capacitances \( C_s \) was calculated by integrating the discharge portions of the CV plot.

\[
C_s = \int I dV / (msV)
\]

(1)

where \( C_s \) is the specific capacitance of the electrode \((F \ g^{-1})\), \( I \) is the response current under the integrated area of the CV curves \((A)\), \( m \) is the mass of the electrode material \((g)\), \( s \) is the scan rate \((V \ s^{-1})\), and \( V \) is the potential window \((V)\).

GCD tests

Based on the charge-discharge curve, the specific capacitances \( C_s \) of the electrode can be calculated using:

\[
C_s = I \Delta t / (m \Delta V)
\]

(2)

where \( I \) is the discharge current \((A)\), \( t \) is the discharge time \((s)\), \( m \) is the mass of the electro-active material \((g)\), and \( V \) is the potential window \((V)\).

Calculation of energy and power densities

The energy \((E)\) and power densities \((P)\) for the supercapacitors was calculated from CV curves at different current densities using equations (3) and (4), respectively.

\[
E = \int V dQ = \int V Idt = I \int V dt = 0.5C_s \times V^2 / 3.6(Wh / kg)
\]

(3)

\[
P = \frac{E}{t} = E \times \frac{s \times 3.6}{V} (kW / kg)
\]

(4)

Where \( C_s \) is the specific capacitance \((F \ g^{-1})\), \( I \) is the current density \((A \ g^{-1})\), \( s \) is the scan rate \((V \ s^{-1})\), \( V \) is the potential window \((V)\).