Large interlayer spacing Nb₄C₃Tₓ (MXene) promotes the ultrasensitive electrochemical detection of Pb²⁺ on glassy carbon electrode

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Supporting Information
1. Synthesis of Nb$_2$AlC and Nb$_4$AlC$_3$ MAX phases

Powders of niobium (Alfa Aesar, 99.98%, -325 mesh), aluminum (Alfa Aesar, 99.9%, -325 mesh), and graphite C (Alfa Aesar, 99%, 7-11 micron) were mixed in ratios of 2Nb:1.3Al:1C for Nb$_2$AlC and 4Nb:1.5Al:2.7C for Nb$_4$AlC$_3$ were mixed for 3h at 56 rpm in a Turbula T2F mixer with yttria-stabilized zirconia balls as mixing media. After mixing, the Nb$_2$AlC powder was furnaced for 4 h at 1600°C with a 10 °C heating rate in a tube furnace under flowing argon. For Nb$_4$AlC$_3$, powders were pressed into ~10 g pellets and furnaced at 1700 °C for 1 h with a 10°C heating rate in a tube furnace under flowing argon. After furnacing, the products were ground to -400 mesh before etching. $^{1,2}$
Fig. S1. EDX data for (a) DL-Nb$_2$CT$_x$ and (b) DL-Nb$_4$C$_3$T$_x$. 
2. Calculation of the electrochemical active surface area using Randles–Sevcik equation

The Randles–Sevcik equation is \( i_p = 2.69 \times 10^5 n^{3/2} A D^{1/2} C^{1/2} \nu^{1/2} \)

Where \( i_p \) = current maximum in amps, \( n \) = number of electrons transferred in the redox event (usually 1), \( A \) = electrode area in cm\(^2\), \( D \) = diffusion coefficient in cm\(^2\)/s, \( C \) = concentration in mol/cm\(^3\) and \( \nu \) = scan rate in V/s.

The \( n^{3/2} \) of 10mM of K\(_3\)[Fe(CN)\(_6\)] is 1 and Diffusion coefficient, \( D \) is 7.6 \times 10^{-6} \text{ cm}s\(^{-1}\). The electrochemical surface area was calculated from the anodic peak current at the scan rate 100mV/s\(^{-1}\).

From the above equation, the electrochemical active surface area was calculated as \( 0.574 \times 10^{-3} \) cm\(^2\) and \( 0.621 \times 10^{-3} \) cm\(^2\) for Nb\(_2\)CT\(_x\) and Nb\(_4\)C\(_3\)T\(_x\) respectively. \(^3\)
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