

Figure S4 | Component-resolved Bode decomposition of the MXene equivalent-circuit response.

(a) Bode magnitude $|Z(\omega)|$ and (b) Bode phase for the measured impedance (symbols) and the total fitted response (solid line), together with the individual circuit contributions decomposed into R_s (series resistance), $j\omega L$ (lead inductance), the interfacial branch ($R_{ct} \parallel CPE_1$), and CPE_2 . This decomposition illustrates how different physical elements dominate distinct frequency regimes: R_s sets the high-frequency real-axis offset, $j\omega L$ produces the high-frequency inductive phase lead, ($R_{ct} \parallel CPE_1$) governs the mid-frequency dispersive arc associated with non-ideal interfacial charge transfer/double-layer behavior, and CPE_2 captures the low-frequency distributed capacitive/pseudocapacitive response. The panel-wise breakdown provides an interpretable link between the fitted parameters and the observed magnitude/phase evolution across the full measurement window.

