

Figure 6 | Identifiability structure of the 7-parameter MXene EIS model under measurement noise. (a)-(b) Distributions of the CPE dispersion exponents α_1 and α_2 recovered from bounded refits across increasing complex-noise levels (scaled by $|Z|$), shown as violin/cluster summaries to visualize concentration, spread, and drift with noise. (c)-(d) Residual–parameter diagnostics for α_1 and α_2 , plotting the true SSE evaluated on the *clean* spectrum versus the recovered exponent value across refits; these panels show how exponent variability translates into fit quality and identify regions where multiple exponent values produce near-equivalent spectral error, consistent with a shallow or correlated manifold. (e) Pearson correlation matrix of the fitted parameter vector $\theta = \{R_s, L, R_{ct}, Q_1, \alpha_1, Q_2, \alpha_2\}$ computed across noisy refits, revealing compensatory trade-offs and coupled directions in parameter space. (f) Thresholded coupling/block map highlighting strongly correlated pairs (e.g., $|r| \geq 0.7$), which delineates the dominant degeneracy structure that limits unique parameter recovery.

