VOLTA Validation Pipeline: H1 (A_{1g}-Voltage Correlation)

(A) Hypothesis Input

H1: The A1g peak center position (cm^{-1}) decreases with increasing voltage during charging, reflecting delithiation-induced M-O bond weakening in Li-rich layered oxides.

(B) Test Proposal Agent

Falsification Test Design:

H_0: Mean correlation ≥ 0 (no redshift)

H_1: Mean correlation < 0 (redshift occurs)

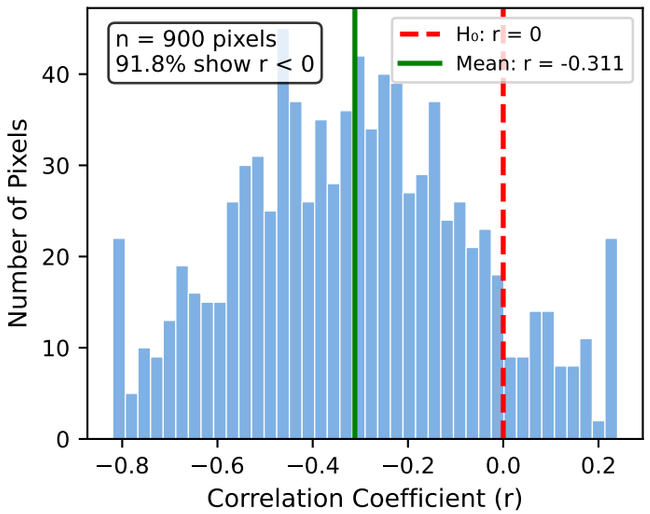
Method: One-sample t-test on pixel-wise correlations

(C) Auto-Generated Code

```
# Test Coding Agent Output
correlations = []
for pixel in pixels:
    r, _ = pearsonr(
    voltage, A1g_center)
    correlations.append(r)

t_stat, p_val = ttest_1samp(
    correlations, 0)
```

(D) Pixel-wise Correlation Distribution



(E) Sequential Testing Results

Statistical Evidence

Sample size:	**900 pixels**
Mean r:	**-0.316**
t-statistic:	**-36.15**
p-value:	**1.1×10^{-177}**
E-value:	**1.5×10^{88}**

Decision: REJECT H_0

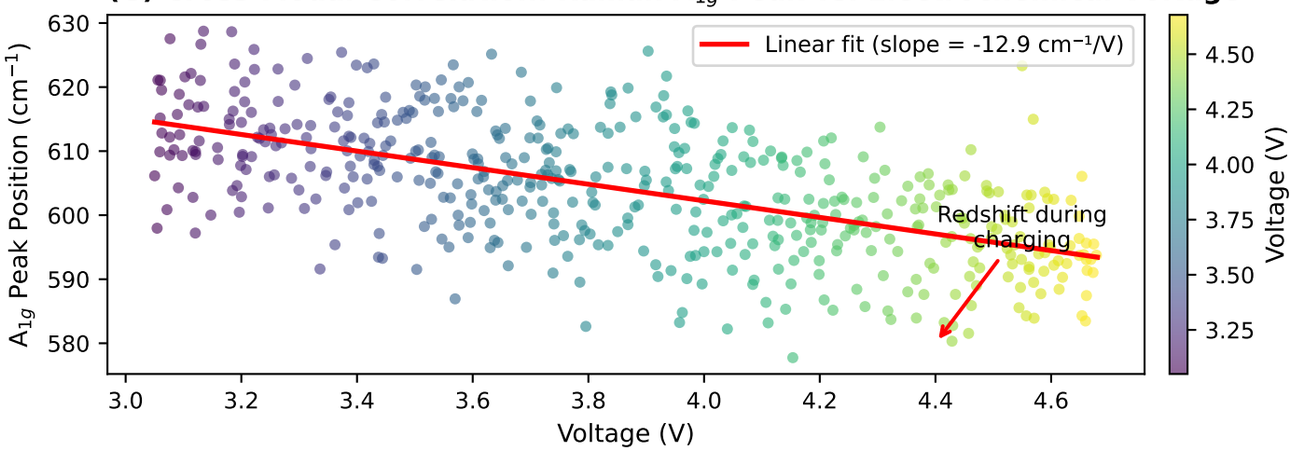
(F) Summarizer Verdict

✓

HYPOTHESIS VALIDATED

The A1g peak shows statistically significant redshift with voltage, consistent with M-O bond weakening during delithiation.

(G) Cross-Modal Correlation: Raman A_{1g} Peak vs. Electrochemical Voltage



(H) E-value Exceeds Threshold