

Supplementary Materials: The following are available online at www.mdpi.com/xxx/s1.

Figure S1: TOF-SIMS 3-D tomography overlay for an ELP copper-plated sample after hydrogen gas anneal (step 4 of Fig. 1). Figure S2: TEM image and APT reconstruction of the interface between the copper electrode (orange) and the dense BZCY electrolyte (green) for a sample after copper plating (step 3 of Fig. 1); second area of analysis.

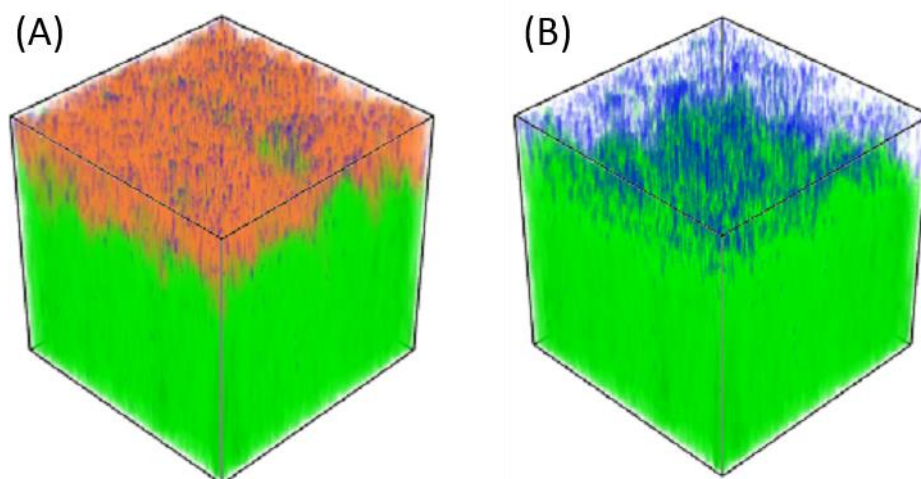


Figure S1. TOF-SIMS 3-D tomography overlay for an ELP copper plated sample after forming gas anneal (step 4 of Figure 1) (A) Barium signal from the BZCY is green, copper signal is orange, palladium signal is blue. (B) same data as in (A), with the copper signal removed to better illustrate the uniform distribution of palladium in the ELP copper electrode. Each dataset is 25x25x3 μm .

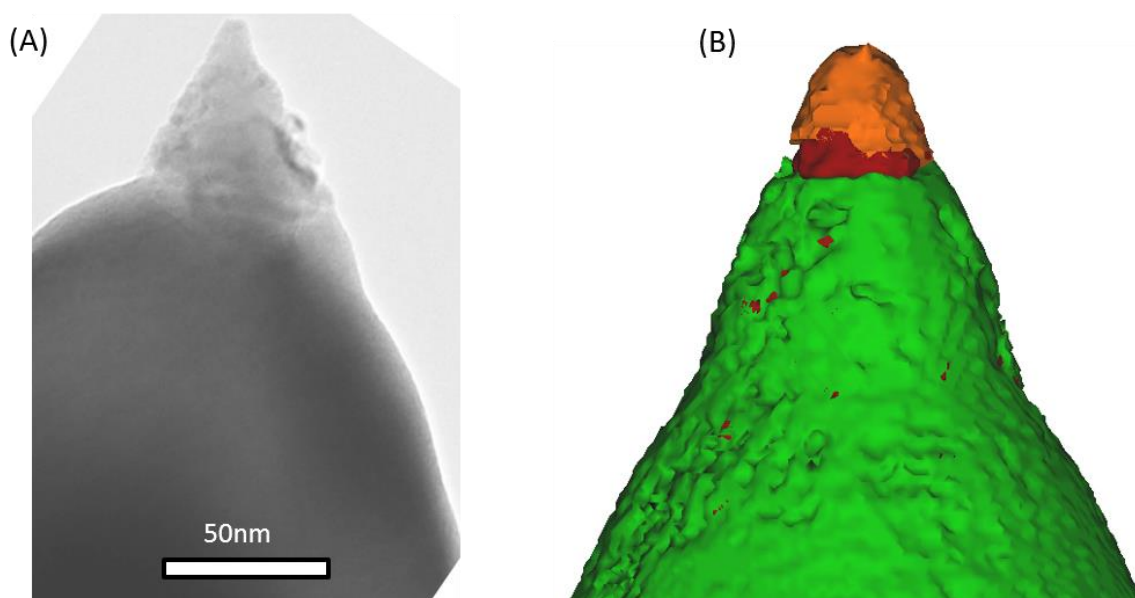


Figure S2. (A) Transmission electron microscopy (TEM) image and (B) atom probe tomography (APT) reconstruction of the interface between the copper electrode (orange) and the dense BZCY electrolyte (green) for a sample after copper plating (step 3 of Figure 1). A carbon rich-phase (red) is observed at the interface between the electrode and the electrolyte, consistent with additional APT data on the same sample shown in Fig. 7 and with the TOF-SIMS data.