Supplementary Information

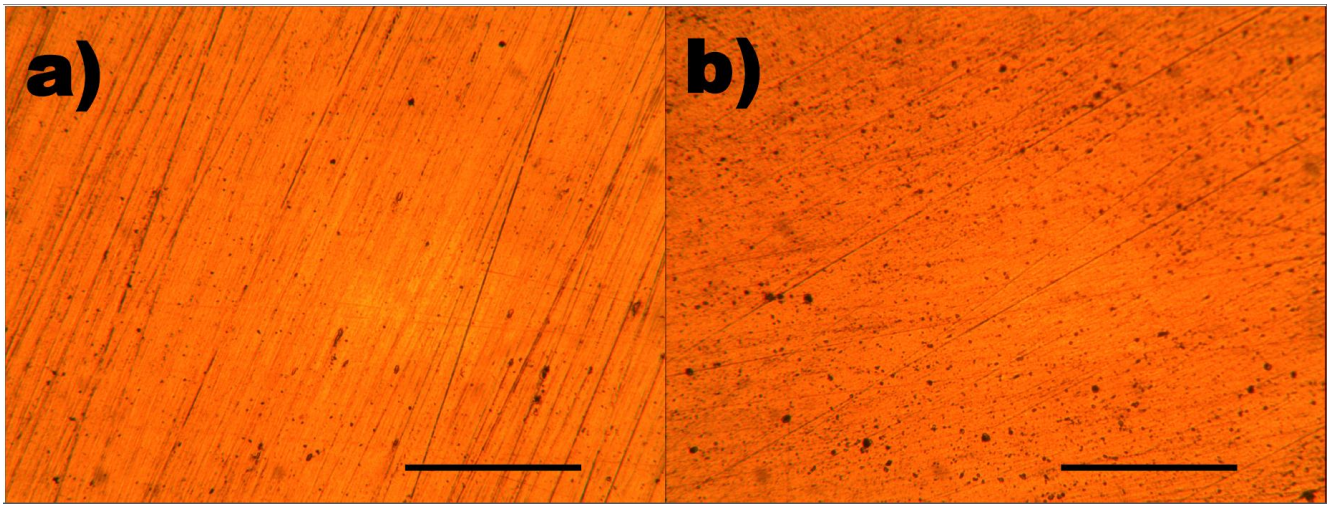

Figure S1. Optical micrographs (200×, scale bars = 500 μm) of the microstructure of the as-received (**a**) M0 copper and (**b**) M1 copper.

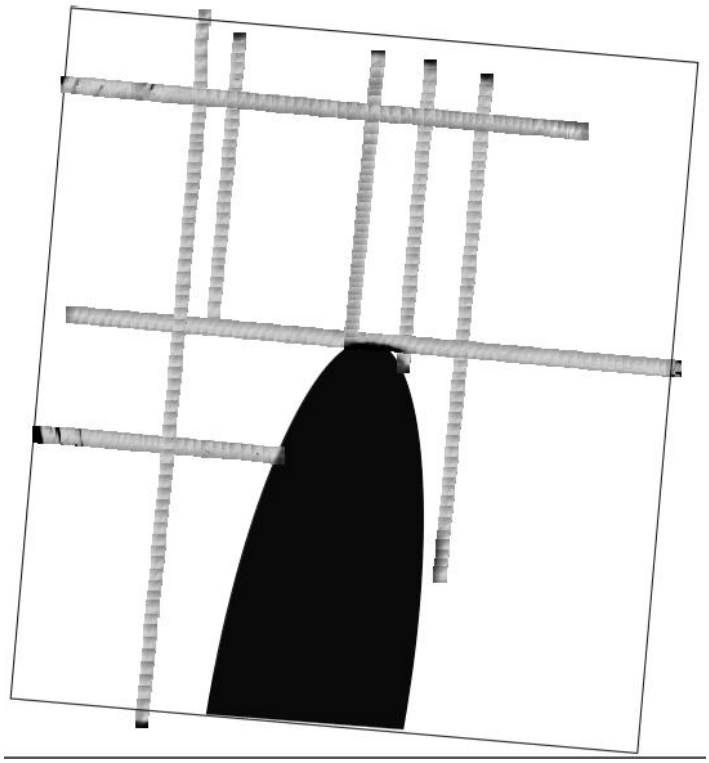

Figure S2. Panoramic images of the microstructure of M1 copper ingot in a "closed" gas flow configuration after undergoing electron beam evaporation. The panoramic 100× optical micrographs (micrograph width = 1.02 mm) show the change in the microstructure across the sample. The sample corresponds to the cross section in Figure 4. The black boarder represents the boarder of the sample used—the upper boarder being the topmost region of the sample, the bottom boarder being the lowermost region. The right-hand boarder corresponds side surface of the ingot while the left-hand boarder is close to the central region of the ingot. The black half-oval represents the channel structure.

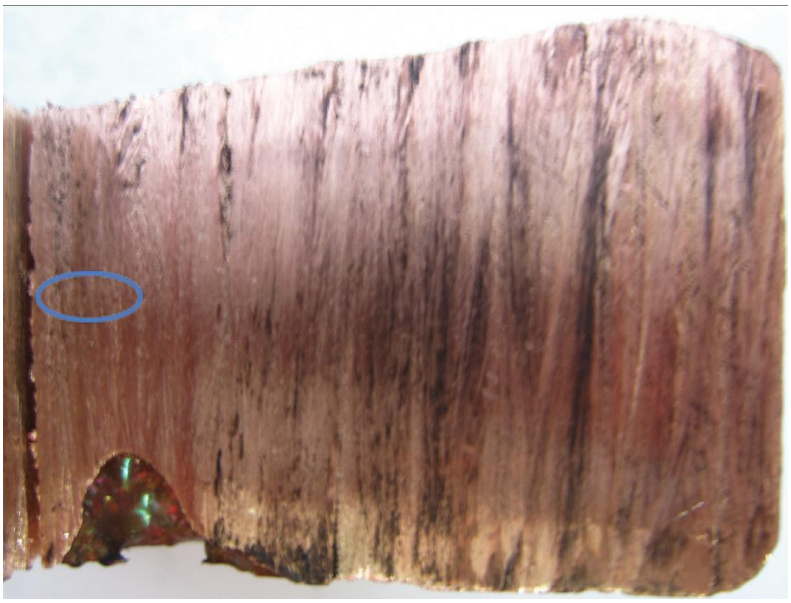

Figure S3. Photograph of a cross-section of a shallower channel structure in the M1 "closed" copper ingot. The approximate location where the copper oxide eutectic phase dominates over the copper phase is indicated with the blue circle.

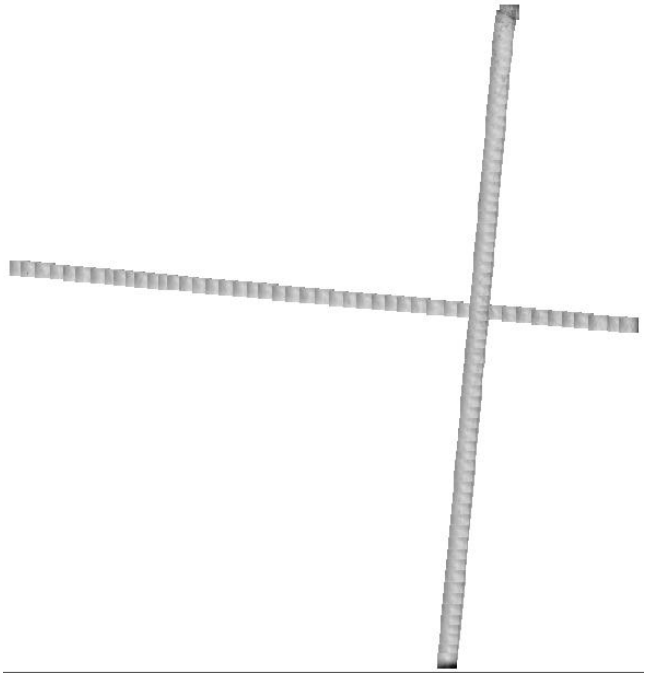

Figure S4. Panoramic optical micrographs (100×, micrograph width = 1.36 mm) of the sample in Figure S3. The top of the vertical panorama ends at the top surface of the ingot while the bottom ends at the tip of the small channel structure. The left-hand side of the horizontal panorama ends at the copper-graphite crucible interface while the right-hand side ends near the center of the ingot.

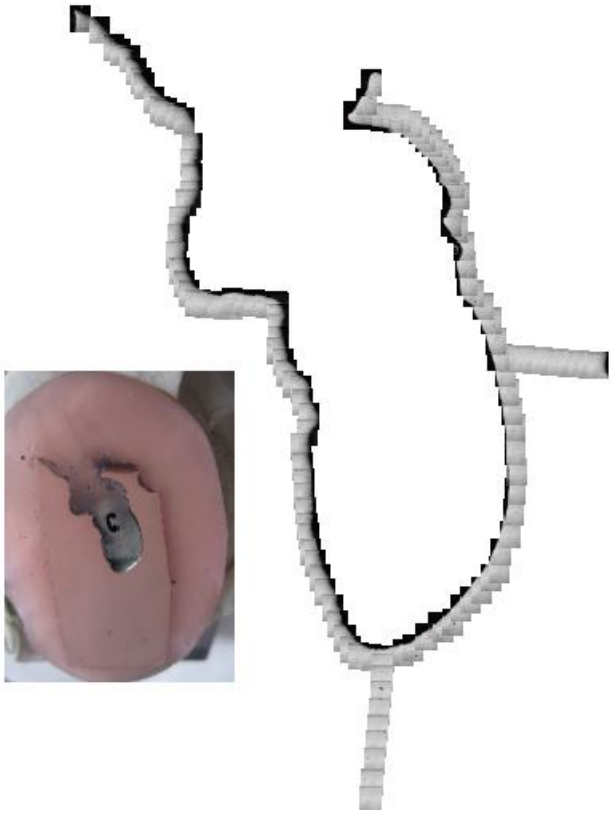

Figure S5. Panoramic optical micrographs (100×, micrograph width = 1.02 mm) around the cavity observed in the M0 "closed" copper sample as shown in Figure 5. The inset shows the corresponding polished copper cross-section which was embedded in plastic for the smoothing and polishing process.

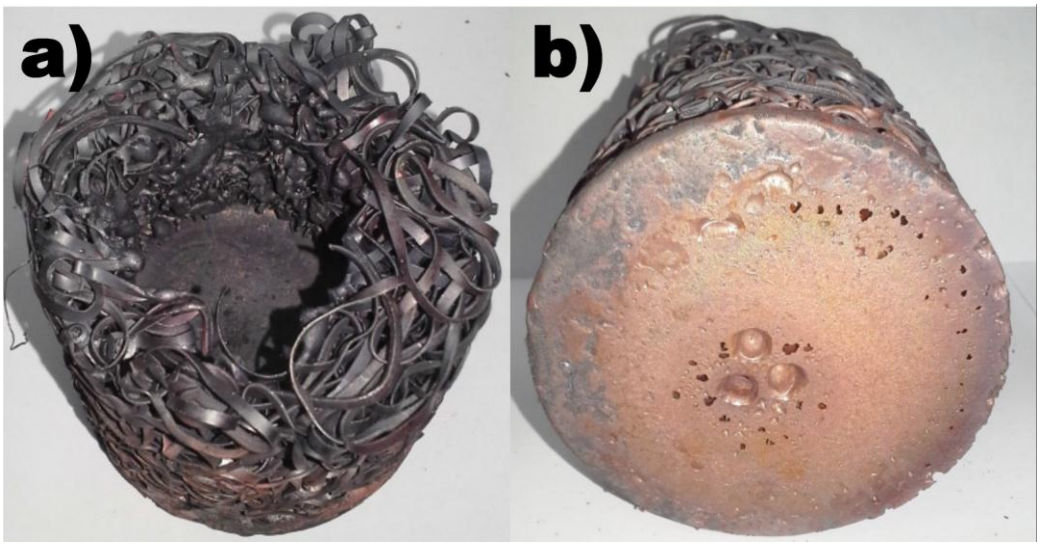

Figure S6. An M1 copper sample created from filling the graphite crucible with copper shavings and heating with an electron beam at 7 mA for 5 min in the "open" gas flow configuration. (**a**) Top view and (**b**) bottom view.

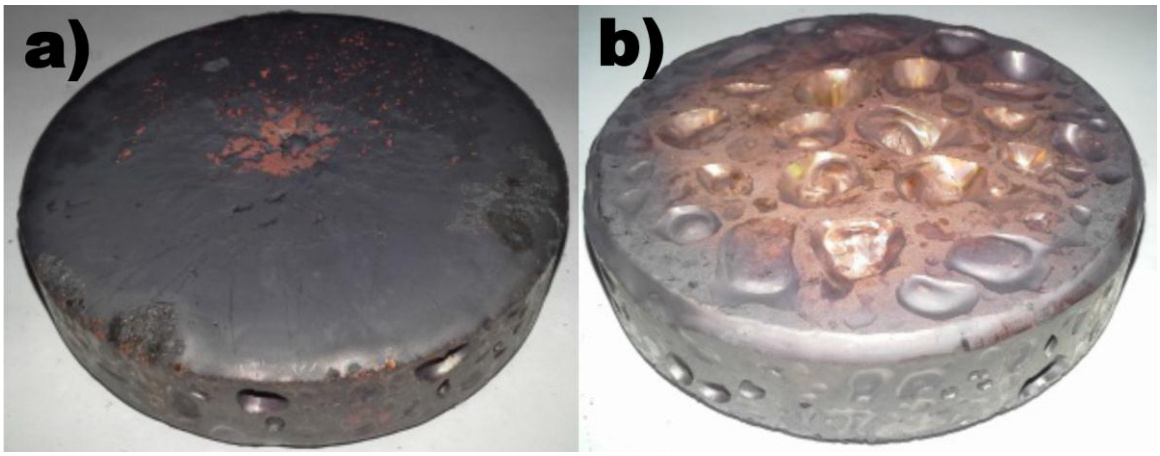

Figure S7. The sample from Figure S6 further irradiated with the electron beam at 7 mA for 20 min with a graphitic cover over the areas of the crucible not hit by the electron beam. **a**) Top view and **b**) bottom view.