Supporting Information:

Cementation of Colloidal Particles on Electrodes in a Galvanic Microreactor

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SUPPORTING INFORMATION

Videos.

SI_video1.avi: Corresponds to time lapse sequence of Figure 2(a) in the manuscript at 10× speed.

SI_video2.avi: Corresponds to time lapse sequence of Figure 2(b) in the manuscript at 10× speed.

SI_video3.avi: Corresponds to time lapse sequence of Figure 2(c) in the manuscript at 10× speed.

X-ray Diffraction (XRD) Spectroscopy. Figure SI1 shows XRD spectrum taken on (a) (100) silicon wafer, which is the substrate underneath the patterned Cu-Au thin film electrode, (b) a galvanic electrode ($w \approx 50$ μm, $s \approx 50$ μm) before the reaction, and (c) the galvanic electrode following ≈ 45 min reaction with pH 3 HCl. Following the reactions, we observe the appearance

of a Cu_2O (111) peak compared to the background spectrums of (a) and (b). This electrode geometry was chosen because it produced a dense layer of reaction products that results in sufficient signal for detection by XRD.

Evaluation of minimum pH increase. We expect that the final pH of the microreactor is always increased either due to incomplete conversion of cuprous chloride to cuprous oxide by reaction Eq. (4) or due to the reduction reaction Eq. (5) which occurs to balance Cu^{2+} formation pathway Eq. (1-3). To determine the minimum pH increase in the microreactors and because chloride is a limiting reactant, we assume that the dissolution reaction will proceed via pathway Eq. (1-2) until either chloride or copper is depleted before proceeding via Eq. (3). Then, we assume the complete conversion of cuprous chloride complex to cuprous oxide by the deposition reaction Eq. (4) until copper, oxygen, or hydronium runs out. In essence, the minimum pH change in the microreactor is evaluated by considering the extent of the reduction reaction pathway Eq. (1-3) which has proceeded to electrically balance oxidation reaction (5).

AUTHOR INFORMATION

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ABBREVIATIONS

XRD, X-ray diffraction.

FIGURES

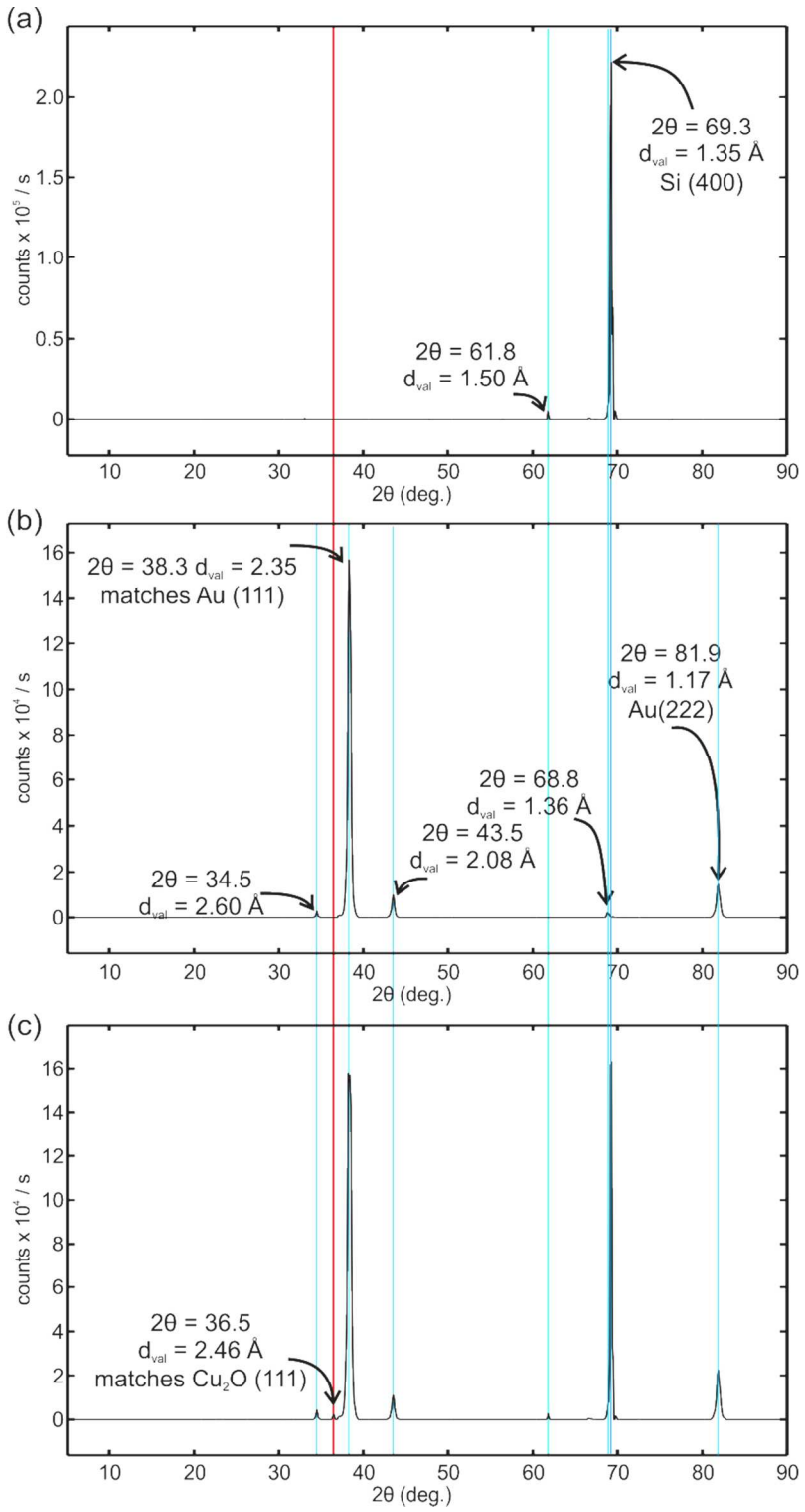
(a)
counts x 10⁵ / s
2θ = 69.3
d_val = 1.35 Å
Si (400)
2θ = 61.8
d_val = 1.50 Å
2θ (deg.)
(b)
counts x 10⁴ / s
2θ = 38.3 d_val = 2.35
matches Au (111)
2θ = 81.9
d_val = 1.17 Å
Au(222)
2θ = 68.8
d_val = 1.36 Å
2θ = 43.5
d_val = 2.08 Å
2θ = 34.5
d_val = 2.60 Å
2θ (deg.)
(c)
counts x 10⁴ / s
2θ = 36.5
d_val = 2.46 Å
matches Cu2O (111)
2θ (deg.)

Figure SI1. XRD spectrum of (a) (100) silicon wafer (substrate for patterned Cu-Au thin film electrode), (b) a galvanic electrode ($w \approx 50$ μm, $s \approx 50$ μm) before the reaction and (c) the galvanic electrode following ≈ 45 min reaction with pH 3 HCl, which shows the appearance of a Cu_2O (111) peak.