Annealing Effects and Photoelectric Properties in Single-Oriented Cu_2O Films Electrodeposited on Au(111)/Si(100) Substrates

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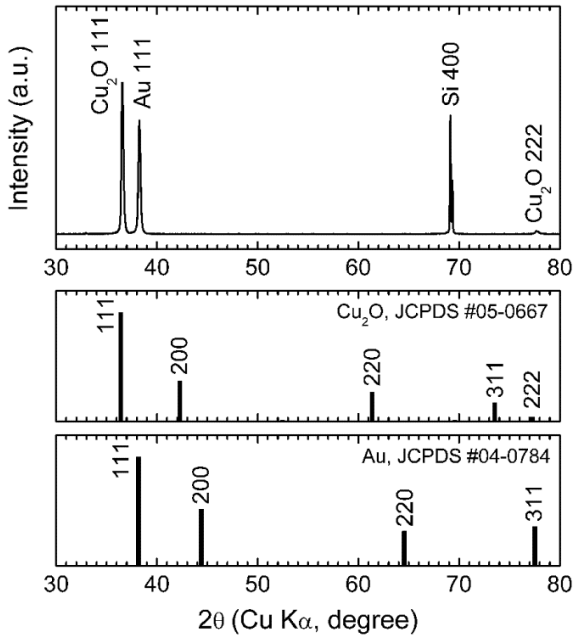

Figure S1. XRD pattern of an as-deposited Cu_2O film electrodeposited on a Au(111)/Si(100) substrate. JCPDS data for Cu_2O (#05-0667) and Au (#04-0784) are also presented.

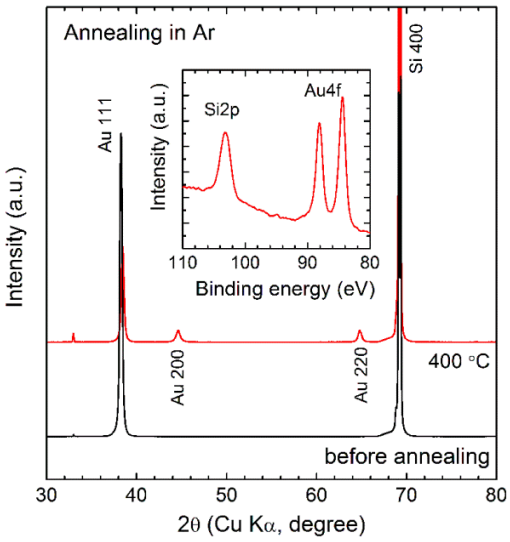

Figure S2. XRD patterns of Au(111)/Si(100) substrates before and after annealing at 400 °C in Ar atmosphere. Inset shows XPS spectrum of the surface of the annealed Au(111)/Si(100) substrate.

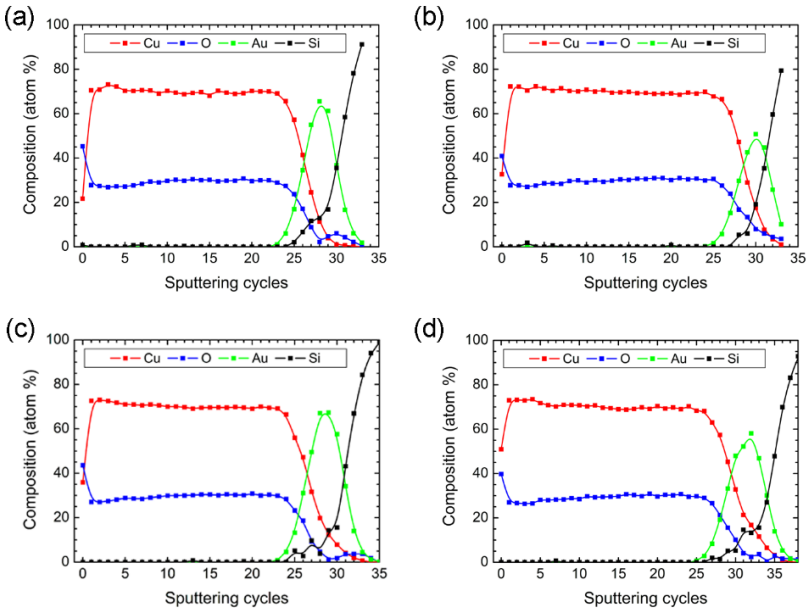

Figure S3. XPS depth profiles of (a) an as-deposited Cu_2O film (~0.5 μm thickness) electrodeposited on a Au/Si substrate, and Cu_2O films annealed in Ar at (b) 300, (c) 350, and (d) 400 °C for 1 h. Etching (one cycle = 10 min) was performed with Ar ion sputtering.

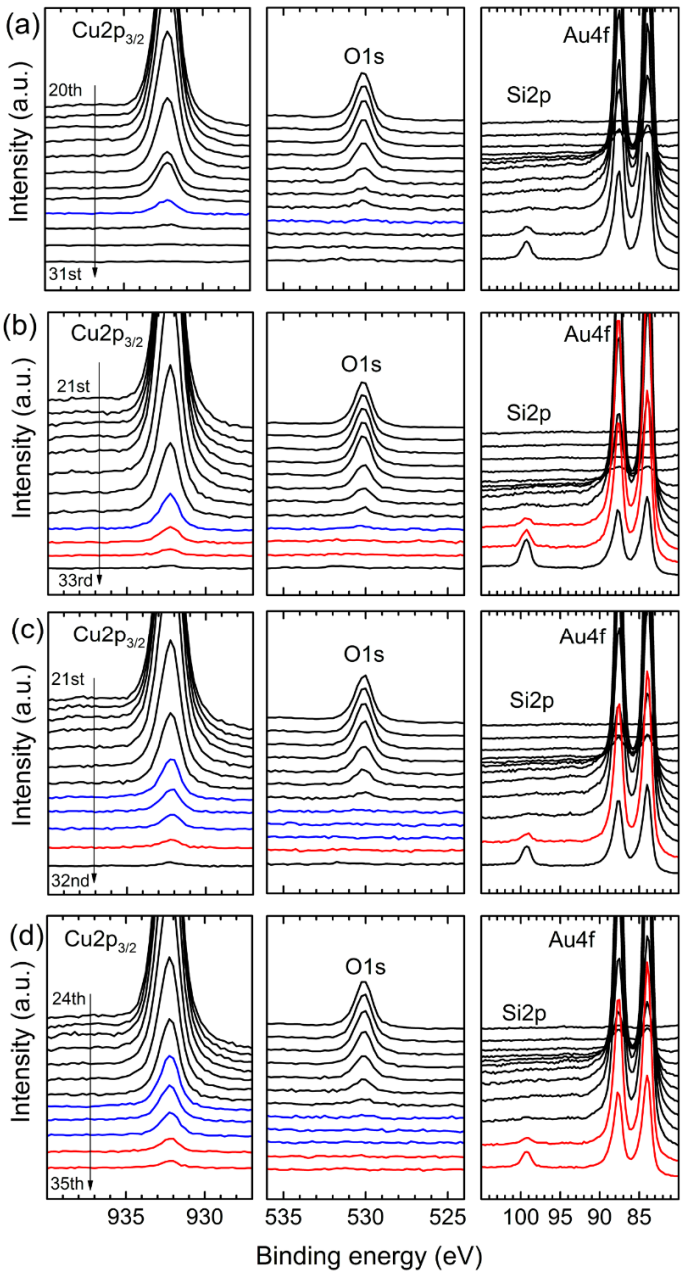

Figure S4. XPS spectra in the vicinity of the Cu_2O/Au/Si interface for (a) an as-deposited Cu_2O film electrodeposited on a Au/Si substrate, and Cu_2O films annealed in Ar at (b) 300, (c) 350, and (d) 400 °C for 1 h. Etching (one cycle = 10 min) was performed with Ar ion sputtering. Blue and red lines indicate that Cu $2p_{3/2}$ peak exists without O 1s peak, and Cu $2P_{3/2}$ peak exists with Si 2p peak (without O1s peak), respectively.

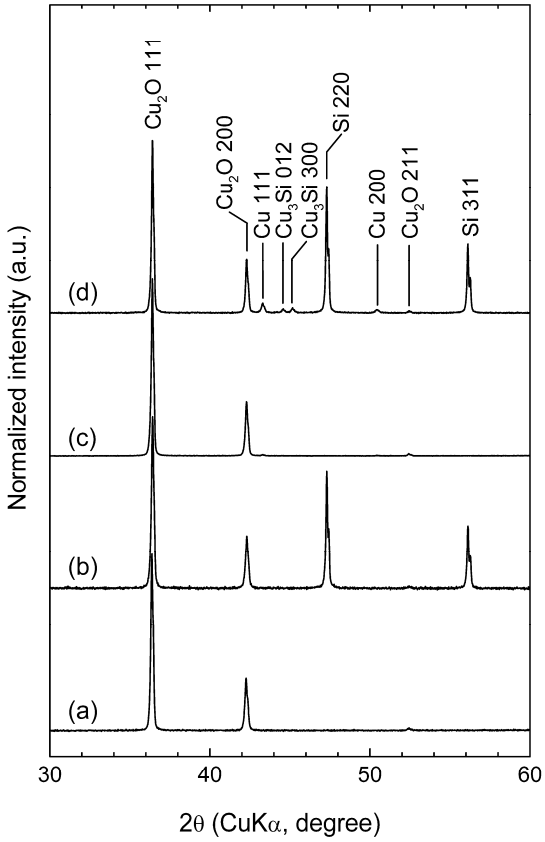

Figure S5. XRD patterns of (a, c) Cu_2O powder and (b, d) a mixture of Cu_2O and Si powders (Cu_2O : Si = 1 : 10), before (a, b) and after (c, d) annealing at 500 °C for 1 h under vacuum (~5×10^{-4} Pa).

The effect of Si on the reduction of Cu_2O was examined using reagent grade Cu_2O and Si powders. Annealing of the Cu_2O powder was performed with and without Si powder at 500 °C for 1 h under vacuum (~5×10^{-4} Pa). The obtained powders were then subjected to XRD measurements. As shown in Fig. S5, Cu metal diffraction peaks were detected only after the annealing in the presence of Si, indicating that Si stimulates the reduction of Cu_2O to Cu metal via the following reaction: $2Cu_2O + Si \rightarrow 4Cu + SiO_2$.