Optimization of the processing parameters for the preparation of dip-coated CuO photocathodes and modification with Au nanoparticles for water-splitting

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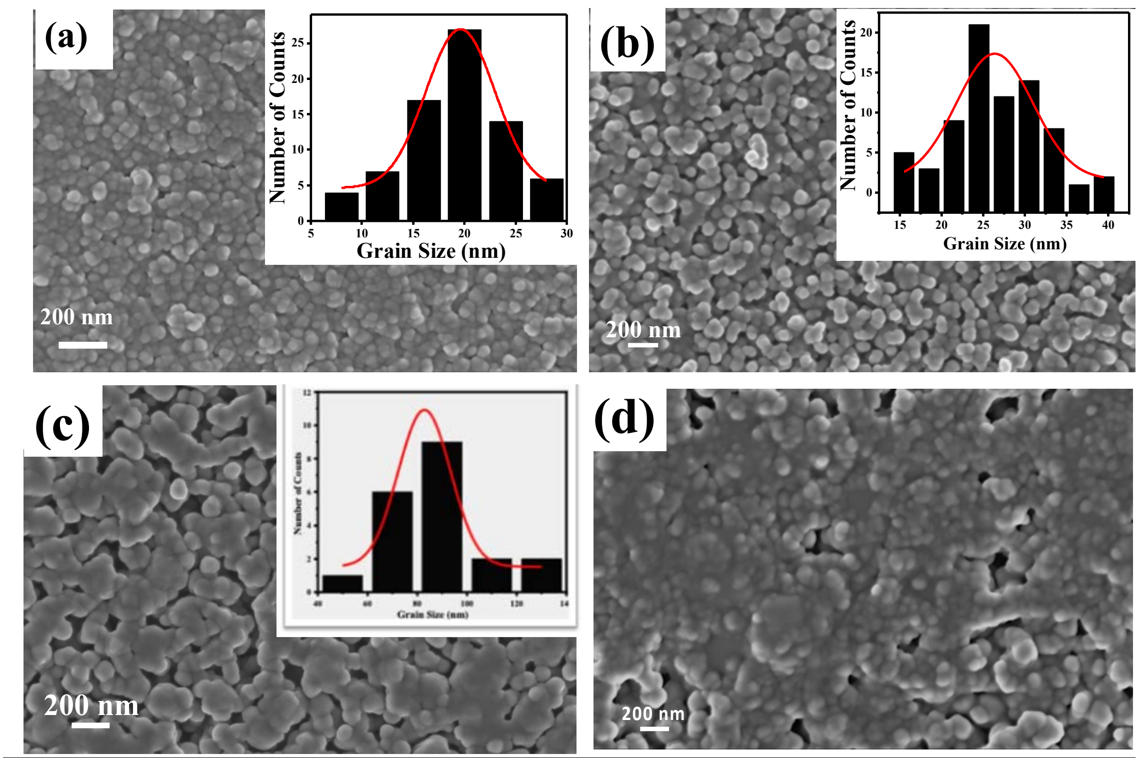

Fig. S1. FE-SEM micrographs of CuO thin films consisting of **(a)** 5, **(b)** 7, and **(c)** 10 layers with the insets showing the histograms of their particle size distribution, respectively: (d) shows the surface morphology of CuO/Au films.

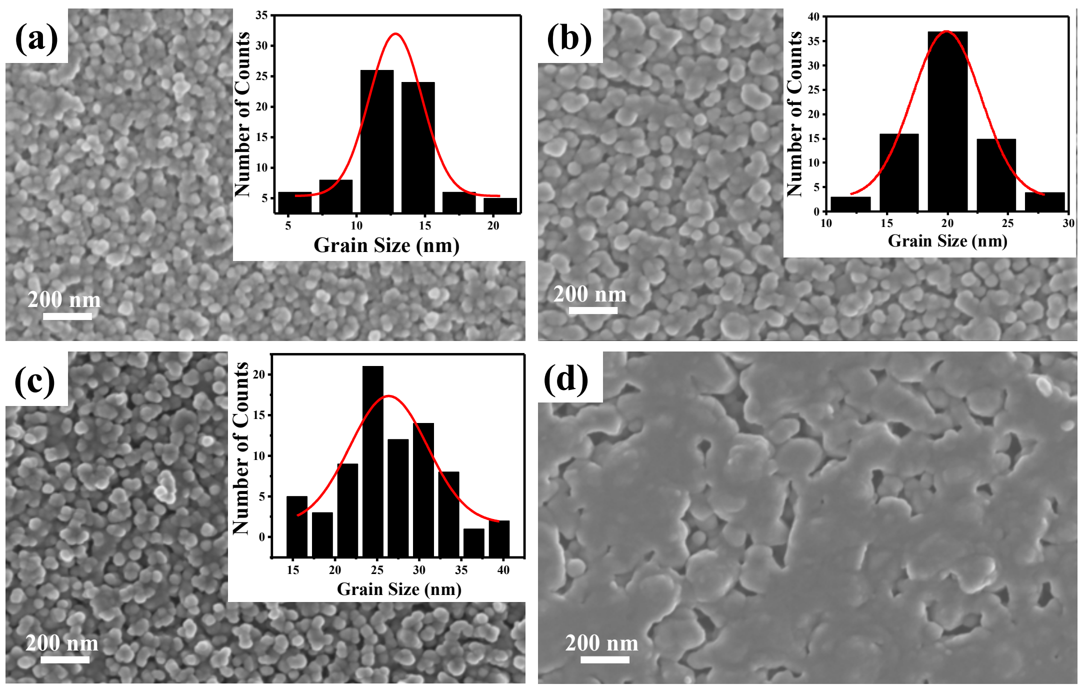

Fig. S2. FE-SEM micrographs of CuO thin films annealed at different temperatures of **(a)** 400°C, **(b)** 500°C **(c)** 600°C and **(d)** 650°C together with the corresponding histograms of their particle size distribution.

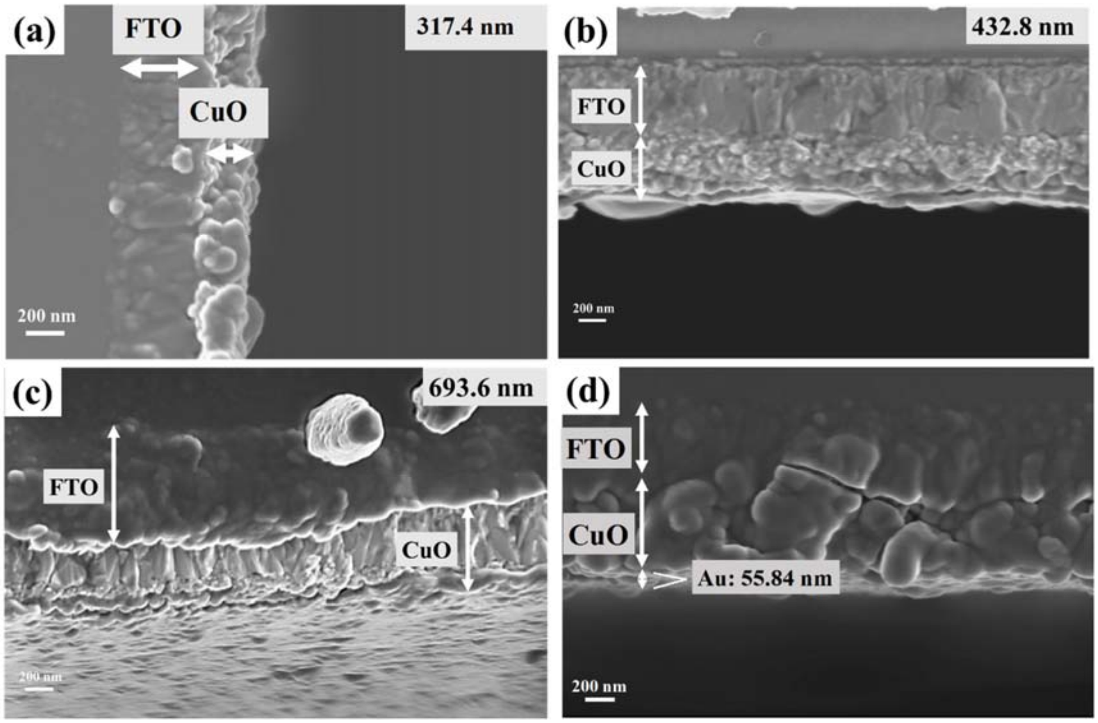

Fig. S3. FE-SEM Cross-sectional views of CuO thin films consisting of **(a)** 5 layers, **(b)** 7 layers **(c)** 10 layers, and (d) 7 layers/Au respectively.

Table S1. Summary of the film thickness estimated for CuO/Au films and the CuO samples prepared at various withdrawal velocities and number of film layers.

Sample	Thickness (nm)
50 mm	239.7 ± 23
100 mm	277.3 ± 32
150 mm	317.4 ± 40
200 mm	355.2 ± 22
CuO-5L	317.4 ± 40
CuO-7L	432.8 ± 27
CuO-10L	693.6 ± 35
CuO-7L-Au	55.8 ± 12

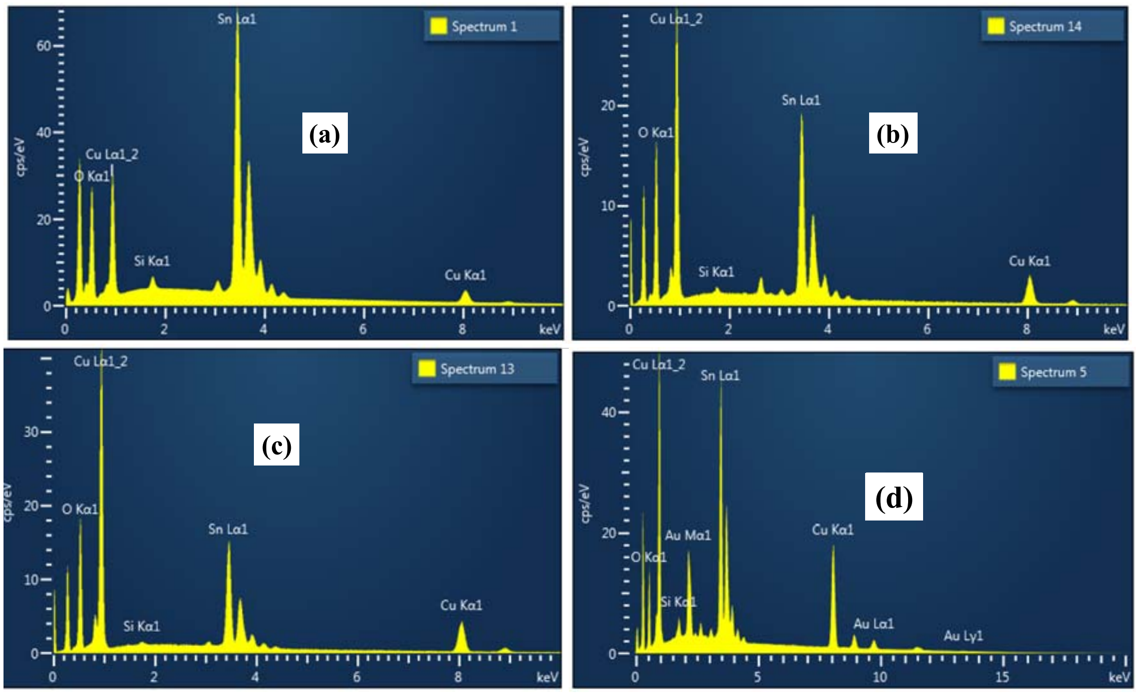

Fig. S4. EDS analysis of CuO thin films consisting of **(a)** 5 Layers, **(b)** 7 Layers, **(c)** 10 layers and (d) 7 Layers/Au respectively.

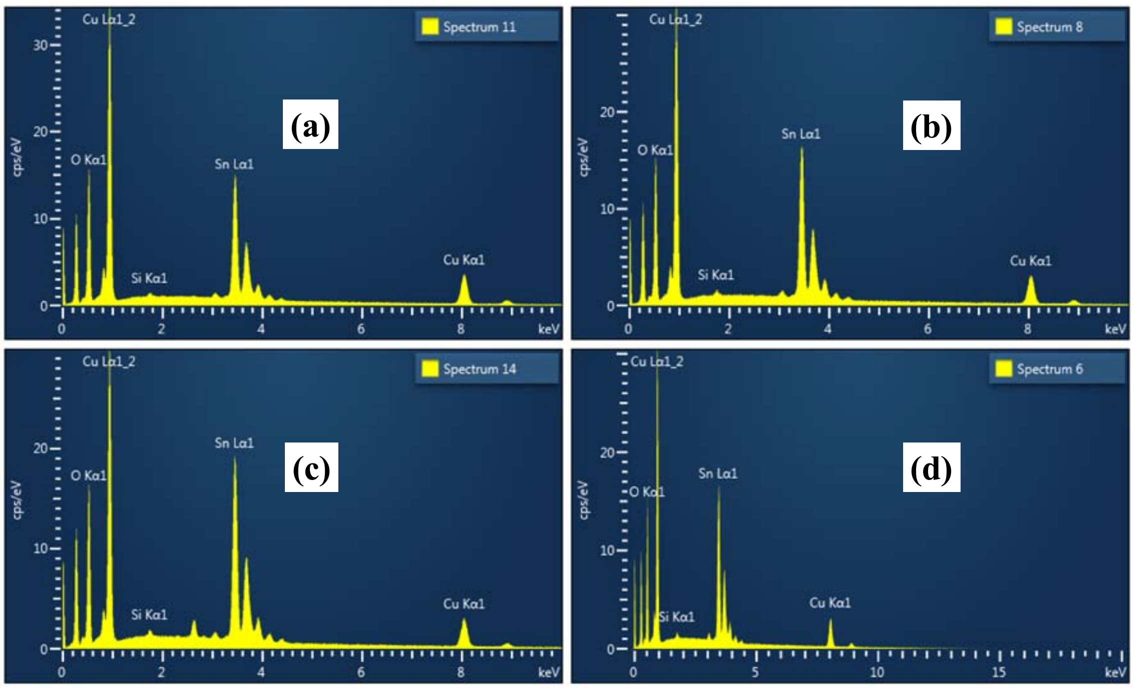

Fig. S5. EDS analysis of CuO thin films annealed at different temperatures of **(a)** 400 °C **(b)** 500 °C **(c)** 600 °C and **(d)** 650 °C.

Table S2. The approximate flat-band potential and charge carrier concentration values calculated for the CuO and CuO/Au photocathodes.

Sample	V_{fb} vs RHE (V)	$N_D * 10^{20}$ (cm^{-3})
7 Layers	1.049	0.90
7 Layers/Au	0.877	5.64

The flat-band potential and charge carrier concentration were calculated for the CuO and CuO/Au photocathodes using the Mott-Schottky relation in Eq. S1:

$$\frac{1}{C^2} = \frac{-2}{\varepsilon\varepsilon_0 e A^2 N_A}\left(V - V_{FB} + \frac{kT}{e}\right) \qquad \text{Eq. S1}$$

where C is the capacitance of the space-charge layer, **ε** is the dielectric constant of the material, $\boldsymbol{\varepsilon_o}$ is the vacuum permittivity with a numerical value of 8.85×10^{-14} F/cm and *e* is the electronic charge with a value of 1.602×10^{-19} C, A is the surface area of the electrode, N_A is the acceptor density, V represent the applied voltage, V_{FB} is the flat-band potential, K is the Boltzmann constant, and T stands for the temperature.