Effect of Multifunctional $(\text{NH}_4)_2\text{SO}_4$ and Co-deposition Factors on Porous Copper Film

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In this study, porous copper film was prepared by a co-deposition process, which used $(\text{NH}_4)_2\text{SO}_4$, a hydrogen source, as dynamic templates. To improve the morphology of porous copper film, sodium citrate was added into the base co-deposition solution as a chemical additive. The phase composition of co-deposited porous copper film was examined by X-ray diffractometer (XRD), while its morphology and nanostructure features were characterized by scanning electron microscopy (SEM) and transmission electron microscopy (TEM). The porous copper films with earhead-like nanodendrites were synthesized in the base deposition solution by the addition of $(\text{NH}_4)_2\text{SO}_4$ which served as an appropriate hydrogen source and suppressed both copper deposition and hydrogen bubbles coalescence. Meanwhile, the porous copper film obtained from the optimized solution containing $(\text{NH}_4)_2\text{SO}_4$ and sodium citrate displayed better morphology and structure features. The effect mechanism of $(\text{NH}_4)_2\text{SO}_4$ and sodium citrate on the morphology and nanostructure of porous copper film at a 3.0 A cm^{-2} current density was discussed. Moreover, the effects of CuSO_4 concentration and co-deposition current density on porous copper films were respectively investigated. The results demonstrated that the pore size and wall thickness would remarkably increase while the CuSO_4 concentration increased. Besides, the porous copper structure started to appear with the walls becoming denser when co-deposition current density increased.

Keywords: porous copper film; $(\text{NH}_4)_2\text{SO}_4$; sodium citrate; CuSO_4 concentration; current density

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