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Pulse electrodeposition of copper-manganese alloy in deep eutectic solventWei-Shen Chiang^a, Jun-Qian Huang^b, Po-Chun Chen^{b,*}, Pu-Wei Wu^{a,*}Aniruddha Joi^c, Yezdi Dordi^c^aDepartment of Materials Science and Engineering, National Chiao Tung University

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Copper-manganese alloy has been established to improve resistance toward electromigration for interconnects. In this work, we employ a deep eutectic solvent (DES) to formulate a nonaqueous electrolyte for pulse current electrodeposition of Cu-Mn alloyed film. Using impedance spectroscopy to record ionic conductivities of DES-based electrolytes, we determine the optimized bath with a Cu/Mn molar ratio of 1:20. We produce a uniform, smooth, and composition-controllable CuMn alloyed film after exploring various pulsing parameters. Signals from X-ray diffractometer (XRD) suggest successful alloying of Cu and Mn with minor presence of MnO₂. Profiles from X-ray photoelectron spectroscopy (XPS) validate the metallic nature of Mn from the as-deposited film. Upon Ar annealing, both XRD and XPS exhibit strong signals of MnO₂ formation. In addition, images from transmission electron microscope and qualitative elemental chemical mapping indicate Mn atoms in CuMn alloy either diffuse through the underlying Cu seed layer and segregate at the Cu/SiO₂ interface, or migrate toward the external surface forming MnO₂.

Keywords: Cu-Mn alloy; Deep eutectic solvent; Pulse electrodeposition;
Diffusion barrier

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