

Microstructure control of copper films by addition of molybdenum in an advanced metallization process

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ABSTRACT

The effect of annealing on the resistivity, morphology, microstructure, and diffusion characteristics of Cu(Mo)/SiO₂/Si and Ti/Cu(Mo)/SiO₂/Si multilayer films has been investigated in order to determine the role of Mo. In the case of a Cu(Mo)/SiO₂/Si multilayer, most of the Mo diffused out to the free surface to form MoO₃ at temperatures up to 500 °C and complete dissociation of Mo occurred at higher temperatures. The segregation of Mo to the external surface leads to Mo-free Cu films with extensive grain growth up to 20 times the original grain size and strong (111) texture. In the case of a Ti/Cu(Mo)/SiO₂/Si multilayer, a thin Ti film prohibits Cu agglomeration, out-diffusion of Mo, and diffusion of Cu into SiO₂ at temperatures up to 750 °C. Cu(Mo) grain growth was less extensive, but (111) fiber texturing was much stronger than in the case of Cu(Mo)/SiO₂/Si. In the current study, significant changes in microstructure, such as a strong (111) texture and abnormal grain growth, have been obtained by adding Mo to Cu films when the films are annealed.

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