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Thermal stability of AlCrTaTiZrMo-nitride high entropy film as a diffusion barrier for Cu metallization

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Abstract: In this study, an amorphous (AlCrTaTiZrMo)N senary nitride film was prepared by DC reactive magnetron sputtering as a single-layer barrier material for Cu interconnection. To evaluate its thermal stability, Cu/(AlCrTaTiZrMo)N/Si structure was annealed at 600 °C for different amounts of time in high vacuum to simulate the actual working environment. The layer maintained a suitable thermal stability after annealing for 7 h. No large holes or cracks were observed on the surface, and the layer remained amorphous without any grain boundaries and maintained excellent interface adhesion with the Cu and Si. The minimal amount of Cu that diffused into the layer suggested that inter-diffusion between the Cu and Si atoms was effectively suppressed. The excellent diffusion barrier performance and high temperature long-term thermal stability is attributed to the stable amorphous structure with no rapid diffusion path, and its structural and chemical stability. Thus, the amorphous (AlCrTaTiZrMo)N thin film can be used for Cu interconnections as a reliable and effective material.

Key words: High-entropy alloy, Diffusion barrier, Thermal stability, Amorphous structure

Introduction

With the rapid development of integrated circuits, the requirements for circuit density and resistance-capacitance (RC) delay have continuously increased[1,2]. Cu has

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