T2-P031

Superconformal gap-filling of nano trenches by metalorganic chemical vapor deposition (MOCVD) with hydrogen plasma treatment

H. K. Moon, N.-E. Lee

Department of Advanced Materials Science and Engineering, Sungkyunkwan University

As the trench width in the interconnect technology decreases down to nano-scale below 50 nm, superconformal gap-filling process of Cu becomes very critical for Cu interconnect. Obtaining superconfomral gap-filling of Cu in the nano-scale trench or via hole using MOCVD is essential to control nucleation and growth of Cu. Therefore, nucleation of Cu must be suppressed near the entrance surface of the trench while Cu layer nucleates and grows at the bottom of the trench. In this study, suppression of Cu nucleation was achieved by treating the Ru barrier metal surface with capacitively coupled hydrogen plasma. Effect of hydrogen plasma pretreatment on Cu nucleation was investigated during MOCVD on atomic-layer deposited (ALD)-Ru barrier surface. It was found that the nucleation and growth of Cu was affected by hydrogen plasma treatment condition. In particular, as the plasma pretreatment time and electrode power increased, Cu nucleation was inhibited. Experimental data suggests that hydrogen atoms from the plasma was implanted onto the Ru surface, which resulted in suppression of Cu nucleation owing to prevention of adsorption of Cu precursor molecules. Due to the hydrogen plasma treatment of the trench on Ru barrier surface, the suppression of Cu nucleation near the entrance of the trenches was achieved and then led to the superconformal gap filling of the nano-scale trenches. In the case for without hydrogen plasma treatments, however, over-grown Cu covered the whole entrance of nano-scale trenches. Detailed mechanism of nucleation suppression and resulting in nano-scale superconformal gap-filling of Cu will be discussed in detail.