The effect of plamsa treatment on superconformal copper gap-fill

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The effect of forming a passivation layer was investigated in superconformal Cu gap-filling of the nano-scale trench with atomic-layer deposited (ALD)-Ru glue layer. It was discovered that the nucleation and growth of Cu during metal-organic chemical vapor deposition (MOCVD) were affected by hydrogen plasma treatments. Specifically, as the plasma pretreatment time increased, Cu nucleation was suppressed proportionally. XPS and Thermal Desorption Spectroscopy indicated that hydrogen atoms passivate the Ru surface, which leads to suppression of Cu nucleation owing to prevention of adsorption of Cu precursor molecules. For gap-fill property, sub 60-nm ALD Ru trenches without the plasma pretreatment was blocked by overgrown Cu after the Cu deposition. With the plasma pretreatment, superconformal gap filling of the nano-scale trenches was achieved due to the suppression of Cu nucleation near the entrances of the trenches. Even the plasma pretreatment with bottom bias leads to the superconformal gap-filling .