Plasma assisted atomic layer deposition (PAALD) of tantalum nitride for Cu diffusion barrier

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For a Cu diffusion barrier, tantalum nitride (TaN) films have been successfully deposited by plasma assisted atomic layer deposition (PAALD), using pentakis (ethylmethlyamino) tantalum and ammonia as precursors on the SiO_2/Si wafer. One cycle of PAALD consisted of exposure to the metallorganic precursor of PEMAT, a purge period with Ar and Ar plasma, exposure to an NH_3+Ar plasma and finally another purge period with Ar. The growth rate of PAALD TaN was approximately 0.80 □ per cycle at substrate temperature 250□. The thickness of films was linear with the number of cycles, which is a typical feature of ALD process. The N : Ta ratio for TaN film was 47 : 44 in composition and the film contained approximately 3 at.% carbon and 4 at.% oxygen impurity, as determined by Rutherford backscattering spectroscopy (RBS) and auger electron spectroscopy (AES). The stability of 10 nm-thick TaN films as a Cu diffusion barrier was tested through thermal annealing for 30 minutes in N_2 ambient and characterized by the help of XRD and sheet resistance. Consequently, the PAALD grown TaN film maintains the barrier properties against Cu up to 700℃.