

Investigation of TaNx diffusion barrier properties using Plasma-Enhanced ALD for copper interconnection

한동석¹, 문대용¹, 권태석¹, 김웅선², 황창목², 박종완²

¹한양대학교 나노반도체공학과, ²한양대학교 신소재공학과

With the scaling down of ULSI(Ultra Large Scale Integration) circuit of CMOS(Complementary Metal Oxide Semiconductor)based electronic devices, the electronic devices become more faster and smaller size that are promising field of semiconductor market. However, very narrow line width has some disadvantages. For example, because of narrow line width, deposition of conformal and thin barrier is difficult. Besides, proportion of barrier width is large, thus resistance is high. Conventional PVD(Physical Vapor Deposition) thin films are not able to gain a good quality and conformal layer. Hence, in order to get over these side effects, deposition of thin layer used of ALD(Atomic Layer Deposition) is important factor. Furthermore, it is essential that copper atomic diffusion into dielectric layer such as silicon oxide and hafnium oxide. If copper line is not surrounded by diffusion barrier, it cause the leakage current and devices degradation. There are some possible methods for improving the these secondary effects.

In this study, TaNx, is used of Tertiarybutylimido tris (ethylamethylamino) tantalum (TBITEMAT), was deposited on the 24nm sized trench silicon oxide/silicon bi-layer substrate with good step coverage and high quality film using plasma enhanced atomic layer deposition (PEALD). And then copper was deposited on TaNx barrier using same deposition method.

The thickness of TaNx was 4~5 nm. TaNx film was deposited the condition of under 300°C and copper deposition temperature was under 120°C, and feeding time of TaNx and copper were 5 seconds and 5 seconds, relatively. Purge time of TaNx and copper films were 10 seconds and 6 seconds, relatively. XRD, TEM, AFM, I-V measurement(for testing leakage current and stability) were used to analyze this work. With this work, thin barrier layer(4~5nm) with deposited PEALD has good step coverage and good thermal stability. So the barrier properties of PEALD TaNx film are desirable for copper interconnection.