【MP-04】

Tungsten Nitride Film Growth by MOCVD for Cu Diffusion Barrier

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Tungsten nitride (WN_x) films were deposited by metal-organic chemical vapor deposition(MOCVD) using $W(CO)_6$ and NH_3 in the growth temperature range from 250℃ to 500℃ for Cu diffusion barrier. The growth rate was 0.3 ~ 193 nm/min. The film resisitivity decreased from 950 to 590μΩcm, and the impurity concentration of C and O both decreased from 10 to below 5% upon the temperature rise. XRD analysis showed that the film structure changed from an amorphous-like structure to a $W_2N(200)$ phase dominant polycrystalline structure with the temperature rise. Sheet resistance measurements and XRD analysis showed that WN_x barrier of a 15nm thickness blocked the Cu diffusion efficiently up to 600℃ for 1 h annealing.

Now, our MOCVD results at low temperature provide possibility to solve problems from inorganic CVD using WF_6, causing handling problem and halogen residual, as well as PECVD, resulting in plasma defects and step-coverage problem.