(hfac)Cu(1,5-DMCOD) 전구체를 이용한 MOCVD Cu 박막의 증착특성 연구

Deposition of Cu MOCVD using (hfac)Cu(1,5-DMCOD) as a precursor

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1. Introduction

Currently, copper CVD followed by ECD (Electro-Chemical Deposition) have received much attention as the most promising process for void free filling of via and hole structures at near bulk resistivity and high growth rates. However, electroplating is sensitive to the seed layer and requires a continuous, conducting substrate with equivalent thick film resistivity below 2 $\mu\Omega$-cm. Regarding to these concerns, we have investigated the deposition characteristics of Cu MOCVD for the possible application of a seed layer by using (hfac)Cu(1,5-DMCOD) as a precursor. Adding H_2 or H(hfac) to a He carrier gas system dependency of the copper MOCVD was also investigated in the current work.

2. Experimental

MOCVD TiN (1000Å) as diffusion barrier for Cu was deposited from tetrakis-ethylmethyl -amido titanium (TEMAT) as a precursor on a 4′ (100), p-type Si wafer at 350℃, followed by in-situ MOCVD Cu deposition using (hfac)Cu(1,5-DMCOD) as a precursor. Resistivity and Cu film thickness were measured by a 4-point probe method and FESEM (Field Emission Scanning Electron Microscopy), respectively. The distribution of impurities in the films was obtained by AES (Auger Electron Spectroscopy). The surface roughness of the film was estimated by either Nano-spec or SEM. Finally, adhesion between Cu and TiN was evaluated by a scratch test.

3. Results

In the surface reaction limited region, the deposition rate was significantly affected by the substrate temperature and activation energies of 2.1 eV, 1.3 eV, and 1.2 eV were obtained with the He, He + H_2, and He + H(hfac) carrier gas systems, respectively.

The resistivity and thickness of film which was deposited at surface reaction limited region - mass transport limited region transition temperature decreased down to 2.8, 3.2, 2.86 $\mu\Omega$-cm(700, 540, 500Å) with each carrier gas system. The surface morphologies turned into a fluid-like shape at these substrate temperatures. Adhesion of Cu on the TiN substrate showed that good adhesion characteristics were found, especially when He carrier gas was used and no peeling occurred.