In situ FTIR Analysis of Growth Process and Structure Properties of MOCVD Tantalum Nitride by Terbutylimidotris(diethylamido)tantalum

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Tantalum nitride films were prepared by metallorganic chemical vapor deposition using terbutylimidotris(diethylamido)tantalum source with and without NH_3. The deposition was carried out in a cold-wall low-pressure reactor at temperatures ranging from 350 to 600 ^{o}C. The precursor was introduced to the reaction chamber by a bubbler with Ar as a carrier gas. Both deposition temperature and resistivity of the film was found to decrease drastically upon the addition of NH_3. Strong Ta-N double bond in the presursor preserved the TaN portion during the pyrolysis. The TaN films deposited with NH_3 were found to be amorphous by X-ray diffractometry and transmission electron microscopy. Concentration-depth analysis was carried out by Auger electron spectroscopy. The concentrations of carbon and oxygen in films was reduced significantly by using NH_3 as a reactant gas. The gas phase reaction mechanism of the precursor was monitored by in situ Fourier transform infrared spectroscopy. FTIR data suggested that the precursor was decomposed into 2-methylpropane and diethylamine at a temperature 400 ^{o}C. The Ta-N double bond remained at 650 ^{o}C.