XAFS Study of Silicon Oxide Films Fabricated by Atomic-Layer CVD

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Abstract

Silicon oxide films fabricated by atomic-layer CVD (AL-CVD) have been investigated by XAFS. Thin oxide films were deposited by two ways of AL-CVD. The first method used alternate exposure to tetraisocyanatesilane (TICS: $Si(NCO)_4$) and triethylamine (TEA: $N(C_2H_5)_3$) at low pressure. The second method used alternate exposure to TICS and water vapor, with carrier gas at atmospheric pressure. The thickness of films deposited by both methods is independent of source gas exposure times. XPS analysis confirmed that the deposited films are silicon oxide. The deposited films, and a thermal oxide film as the reference, were investigated by XAFS. Si K-edges from the deposited films appear at the photon energy of 1845 eV, which have the same chemical shift as Si K -edge of the thermal oxide. The radial structure functions which were calculated from the spectra have main peaks around 1.4 Å due to the nearest neighbor Si-O pair in the deposited films. The coordination numbers and Si-O bond distances were extracted from the main peaks by using the curve fitting procedure. The both deposited films have the coordination numbers of 4.0. The Si-O bond distances of the oxide films deposited by low pressure AL-CVD and atmospheric pressure AL -CVD are 1.68 and 1.64 Å, respectively.

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