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Electronic and Optical Properties of amorphous and crystalline Tantalum Oxide Thin Films on Si (100)

K. R. Kim[1], D. Tahir[1], Son Lee Seul[1], E. H. Choi[1], S. K. Oh[1], and H. J. Kang[1,a)], D. S. Yang[2], S. Heo[3], J. C. Park[3], J. G. Chung[3] and J. C. Lee[3]

[1]Department of Physics, Chungbuk National University, Cheongju, 361-763, Korea
[2]Physics Division, School of Science Education, Chungbuk National University, Cheongju, 361-763, Korea
[3]Analytical Engineering Center, Samsung Advanced Institute of Technology, Suwun, 440-600, Korea

TaO_2 thin films as gate dielectrics have been proposed to overcome the problems of tunneling current and degradation mobility in achieving a thin equivalent oxide thickness. An extremely thin SiO_2 layer is used in order to separate the carrier in MOSFETchannel from the dielectric field fluctuation caused by phonons in the dielectric which decreases the carrier mobility. The electronic and optical properties influenced the device performance to a great extent.

The atomic structure of amorphous and crystalline Tantalum oxide (TaO_2) gate dielectrics thin film on Si (100) were grown by utilizing atomic layer deposition method was examined using *Ta-K* edge x-ray absorption spectroscopy. By using X-ray photoelectron spectroscopy and reflection electron energy loss spectroscopy (REELS) the electronic and optical properties was obtained. In this study, the band gap (3.400.1 eV) and the optical properties of TaO_2 thin films were obtained from the experimental inelastic scattering cross section of reflection electron energy loss spectroscopy (REELS) spectra. EXAFS spectra show that the ordered bonding of Ta–Ta for c-TaO_2 which is not for a-TaO_2 thin film.

The optical properties' e.g., index refractive (*n*), extinction coefficient (*k*) and dielectric function (*ε*) *were obtained from REELS spectra by using QUEELS-ε(k, ω)-REELS software shows good agreement with other results. The energy-dependent behaviors of reflection, absorption or transparency in TaO_2 thin films also have been determined from the optical properties.*

Keywords: REELS; optical properties, EXAFS, and XPS