Study on evaluation of characteristics of ULSI materials and processes using electron spectroscopy

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It is very important to evaluate characteristics of materials and processes for ULSI devices. The following results are obtained by evaluating the characteristics of materials and processes for the ULSI devices using Auger electron spectroscopy (AES) and X-ray photoelectron spectroscopy (XPS).

(1) The accuracy in band-gap values determined by energy loss spectra included in XPS spectra is decreased in some cases. However, I found that the good accuracy is obtained by using the energy loss spectra of elastic-scattered electrons.

(2) I found that the thickness of silisides depends upon the amount of a Si-C bond (induced by a insulator fabrication process at a side wall) on substrates.

(3) I found that diffusion of oxygen in insulators to substrates upon annealing is suppressed by laminating HfO_2 and SiN thin films alternately. The band gap (6.6 eV) of the laminated films was not changed by elemental compositions and annealing. The band offset for the HfO_2 film was the largest (3.4 eV) and it is decreased with the amount of Hf/(Hf + Si).

(4) The fabrication rate of the SiN film using LPCVD is very slow at the beginning stage of the reaction in the case of presence of strong Si-H and Si-F bonds on the substrates. I found that a thin oxide film is formed on a Ru electrode by fabrication of a Ta_2O_5 film on the electrode.