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Decision of Interface and Depth Scale Calibration of Multilayer Films by SIMS Depth Profiling

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In-depth analysis by secondary ion mass spectrometry (SIMS) is very important for the development of electronic devices using multilayered structures, because the quantity and depth distribution of some elements are critical for the electronic properties. Correct determination of the interface locations is critical for the calibration of the depth scale in SIMS depth profiling analysis of multilayer films. However, the interface locations are distorted from real ones by the several effects due to sputtering with energetic ions. In this study, the determination of interface locations in SIMS depth profiling of multilayer films was investigated by Si/Ge and Ti/Si multilayer systems. The original SIMS depth profiles were converted into compositional depth profiles by the relative sensitivity factors (RSF) derived from the atomic compositions of Si-Ge and Si-Ti alloy reference films determined by Rutherford backscattering spectroscopy. The thicknesses of the Si/Ge and Ti/Si multilayer films measured by SIMS depth profiling with various impact energy ion beam were compared with those measured by TEM. There are two methods to determine the interface locations. The one is the feasibility of 50 atomic % definition in SIMS composition depth profiling. And another one is using a distribution of SiGe and SiTi dimer ions. This study showed that the layer thicknesses measured with low energy oxygen and Cs ion beam and, by extension, with method of 50 atomic % definition were well correlated with the real thicknesses determined by TEM.

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