

Composition Depth Profiling of Fe/Ni and Pt/Co Multilayers Using a Buckminsterfullerene (C_{60}) Ion

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Secondary ion mass spectrometry (SIMS) is a powerful technique for the in-depth analysis of solid materials. However, SIMS is difficult to apply for the quantitative analysis of major components due to severe matrix effects. Therefore SIMS is more commonly used for the quantitative analysis of minor impurities. Fe/Ni and Pt/Co multilayer thin films were grown on Si (100) wafers by ion beam sputter deposition. Fe-Ni and Pt-Co alloy films were also grown for quantitative surface analysis of major components. The compositions of Fe-Ni alloy thin films were certified by an isotope dilution method using inductively coupled plasma-mass spectrometry (ICP-MS) and those of Pt-Co alloys were certified by ICP-optical emission spectroscopy (OES).

An ion beam of buckminsterfullerene (C_{60}^+) has been reported to be useful for depth profiling of a metallic multilayer by lowering the effective sputtering energy and prohibiting surface topographic development. In this study, a C_{60}^+ ion beam was studied as a sputtering source for the quantitative analysis of binary alloy films and the quantitative depth profiling of multilayer films. SIMS depth profiling was performed with a magnetic sector SIMS system using 14.5 keV impact energy C_{60}^+ ions and negative ion detection. No interface artefacts were found in a depth profile of an Fe/Ni multilayer. However, for Pt-Co alloy films, the calibration line slope was 0.898 and the offset value was 3.04 % due to matrix effect.

Figure 1 shows a SIMS depth profile and composition profile of a Pt/Co multilayer. The severe interface artefacts through the Pt/Co and Co/Pt interfaces are quantitatively correlated with the gradual variation of matrix composition at the interfaces. The interface artefact could be compensated by conversion of the profile to a composition depth profile using the calibration curve as shown in Figure 1.

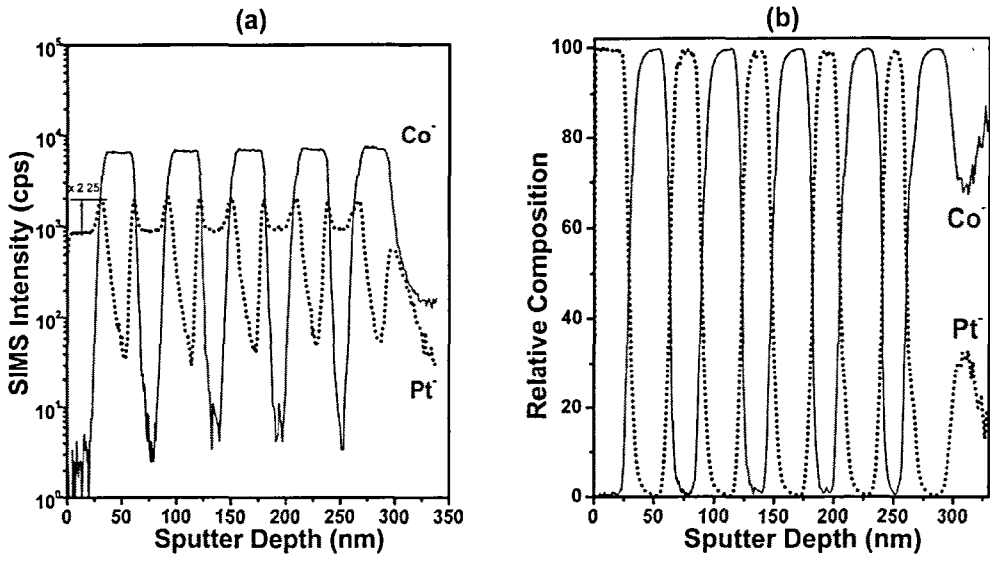


Figure 1. (a) A SIMS depth profile and (b) a composition depth profile of a Pt/Co multilayer film.