Effect of Ag addition on the crystal structure of the β'-phase in Al-Mg-Si alloys

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The metastable phases in Ag-added Al-Mg-Si alloys are not yet clearly understood. In the present work, β' precipitates formed in alloys Al -1.0 mass%Mg_2Si -0.5 mass%Ag (Ag-added) and Al -1.0 mass%Mg_2Si (base) were investigated by High Resolution Transmission Electron Microiscopy (HRTEM) and Selected Area Electron Diffraction (SAED), in order to understand the effect of Ag. The β' phase is rod-shaped; with longest directions parallel to <001>Al. HRTEM images and SAED patterns recorded along these directions were similar for the β' precipitates in both alloys. The unit cell of β'-phase in Ag-added alloy is hexagonal with the same c-axis dimension as the Ag-free β', but with shorter a-axis. Ag was found in the composition of the rod-shaped precipitates in Ag-added alloy by Energy Dispersive X-ray Spectroscopy (EDS). In addition, the distribution of Ag was investigated by Gatan Image Filter (GIF) mapping and High Annular Angular Scanning Transmission Electron Microscopy (HAADF-STEM). One Ag-containing atomic column was observed per β' unit cell, and the unit cell symmetry is slightly changed as compared with the Ag-free β'. The Ag-containing β' rods have complicated structures, with domains separated by anti-phase boundaries. The interfaces of these particles are enriched with Ag atoms that occupy lattice positions on the Al matrix. The occupancy of the Ag-containing atomic columns seems to vary both inside particles, as well as at the interfaces. Figure 1 shows two Ag-containing β' precipitates viewed in cross-section, along their needle lengths that are parallel to <001>Al.

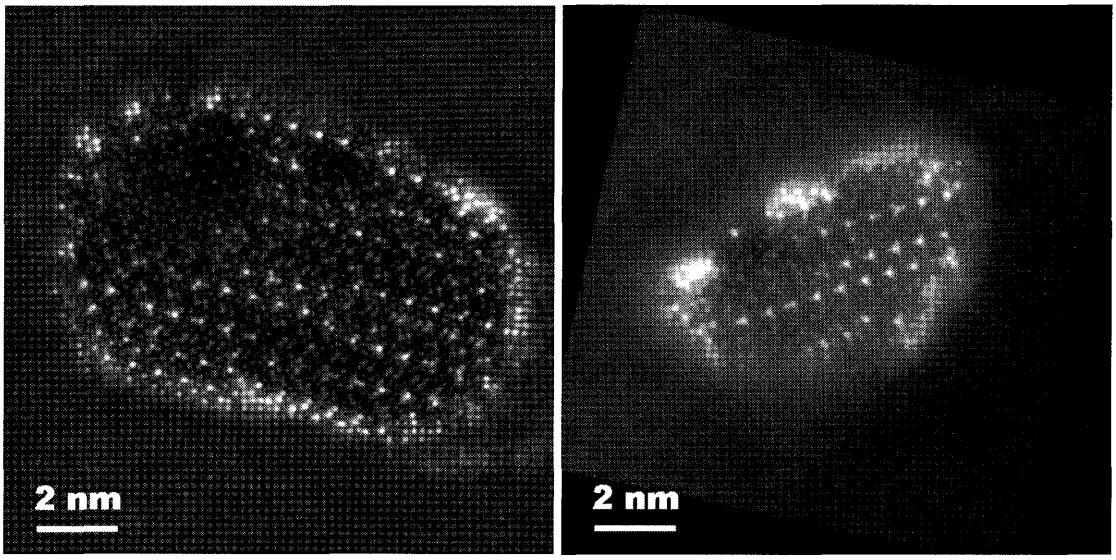

Figure 1 Z-contrast HAADF-STEM images of Ag-containing β' precipitates formed during annealing for 120ksec at 523K (left) and 12Msec at 423K (right).