

Microstructure observation of δ -Ni₂Si in Cu-Ni-Si alloy during aging treatment

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Cu-Ni-Si alloys have been used for electronic equipment parts such as semiconductor lead frames because of their excellent electrical conductivity and strength. Conventionally, Cu-Ni-Si alloy have been strengthened dispersion of fine precipitates (δ -Ni₂Si, orthorhombic) through aging treatment.

Many of researches have been reported about mechanical properties of Cu-Ni-Si alloys. However, any few papers are dealt with crystal structure evolution of both matrix and precipitates using HRTEM.

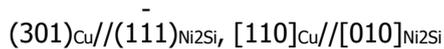
In this research, we investigated the microstructure of matrix and precipitates of Cu-Ni-Si alloys with Ni and Si added above the solid solution limit of Ni₂Si.

The orientation relationship of the precipitates with matrix is reported by Lockyer and Yan as follows.



The shape of Ni₂Si is reported as disk-like. However, there are few detailed reports on changes in morphology due to aging time of precipitates, crystal structure, orientation relationship with matrix.

In over-age, the orientation relationship is reported by Hu as follows.



At the same time, it is said that the shape of Ni₂Si changes from a disk shape to a French baguette bread-slice-shape.

In this study, microstructure observation was conducted using Cu-5.02mass%Ni-1.21mass%Si alloy aged at 753K for each time (early-age, peak-age, over-age).

In the TEM observation, rod-like precipitates were observed. Comparing the SAED pattern of each aging time, the peak of the precipitate was clarified by over-age. As the aging time increased, the lengths of the rod-like precipitates in the long axis direction, the short axis direction, and the aspect ratio all increased. Close inspection of this precipitate using HRTEM revealed a lattice of squares (a=0.71nm, b=0.50nm) considered to be a lattice of Ni₂Si. From this it was revealed as Ni₂Si. The shape of the precipitates from each incident direction of the matrix was considered. The rod-like precipitates could be observed from typical orientation ([001]_{Cu}, [110]_{Cu}, [111]_{Cu}) of copper. Furthermore, an elliptical shape considered to be disk-like projection was observed from each orientation. It can be considered that that this Ni₂Si rod-like precipitate is a cross section of disc precipitate.