CHARACTERIZATION OF AGING BEHAVIOR OF PRECIPITATES AND DISLOCATIONS IN COPPER-BASED ALLOYS

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The electrical conductivity and mechanical properties of precipitate-hardenable Cu-Ni-Si alloys can be improved by an aging treatment. A cold rolling treatment was also made on the alloys prior to the aging treatment, so that crystal defects can promote precipitation. Whereas the strength of the alloys is increased by an adequate aging treatment by which precipitates are formed, the strength is decreased by an over-aging treatment where precipitates are coarsened. Since these aging characteristics depend on the composition of the alloys, quantitative analyses of the structural change of aged samples are indispensable to develop new alloys and the process conditions. The small angle X-ray scattering (SAXS) method and the wide-angle X-ray diffraction method were applied to characterize a growth behavior of precipitates and a variation in the dislocation density in the copper matrix during aging, respectively. In this work, the indirect Fourier transform method was used to estimate a size distribution of precipitates from SAXS data for the present Cu-Ni-Si alloys with different compositions, and the modified Williamson-Hall and modified Warren-Averbach procedures were used for determining the dislocation density. The results showed that the evolution process of precipitates and changes in the dislocation density during aging depend on the compositions of the alloys. On the basis of these structural features, the correlation between the material properties and the composition of the alloys will be discussed.