

Experimental Procedure

(A) Alloy preparation.

Four alloys, $\text{Cu}_{2.9}\text{Mn}_{0.1}\text{Al}$ (alloy A), $\text{Cu}_{2.8}\text{Mn}_{0.2}\text{Al}$ (alloy B), $\text{Cu}_{2.7}\text{Mn}_{0.3}\text{Al}$ (alloy C) and $\text{Cu}_{2.6}\text{Mn}_{0.4}\text{Al}$ (alloy D), were prepared in a vacuum induction furnace under a controlled protective argon atmosphere by using 99.99% copper, 99.9% manganese and 99.99% aluminum. The melts were chill cast into a 30x50x200-mm-copper molds. After being homogenized at 900 °C for 72 hours, the ingots were sectioned into 2-mm-thick slices. These slices were subsequently solution heat-treated at 900°C for 1 hour (in the single β -phase state) and then quenched into iced brine rapidly. The chemical compositions of the present alloys were analyzed by inductively coupled plasma-mass spectrometer (ICP) and listed in Table 1.

(B) Transmission electron microscopy (TEM)

Electron microscopy specimens were prepared by means of a double-jet electropolisher with an electrolyte of 70% methanol and 30% nitric acid. The polishing temperature was kept in the range from -30°C to -15°C , and the current density was kept in the range from 3.0×10^{-4} to 4.0×10^{-4} A/m^2 . Electron microscopy was performed on a JEOL JEM-2000FX scanning transmission electron microscope operating at 200 KV. This microscope was equipped with a Link ISIS 300 energy-dispersive X-ray spectrometer (EDS) for chemical analysis.

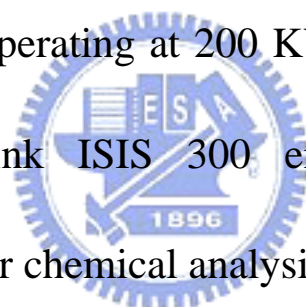


Table 1. Chemical compositions of the phases revealed by inductively coupled plasma-mass spectrometer (ICP).

Alloy	Stoichiometry	Chemical Composition (at. pct.)		
		Cu	Al	Mn
A	$\text{Cu}_{2.9}\text{Mn}_{0.1}\text{Al}$	72.82	24.36	2.82
B	$\text{Cu}_{2.8}\text{Mn}_{0.2}\text{Al}$	70.45	24.57	4.98
C	$\text{Cu}_{2.7}\text{Mn}_{0.3}\text{Al}$	67.51	24.87	7.62
D	$\text{Cu}_{2.6}\text{Mn}_{0.4}\text{Al}$	65.79	24.48	9.73