Phase evolution of Cu-Sn alloy Yuggi, the Korean traditional bronzewear, upon Sn content

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BangJja-Yuggi is fabricated with traditional copper-tin alloy containing 22 wt.% Sn by quenching at high temperature. Recently, BangJja-Yuggi is attracting considerable attention because it has been scientifically proved that it has excellent sterilization effect and thus it can be used as an antibacterial material for medical materials [1-2]. Unfortunately, however, most of its production methods had passed down through the experiential knowledge of minority masters to others. Thus, there is just little systematic and scientific information of the manufacturing technique.

In addition, the microstructure of the traditional Cu-Sn alloys which have 22 ~ 24 wt.% of Sn has not defined exactly until now since the microstructure of Cu-Sn alloy changes very sensitively with the Sn contents as well as heat treatment condition [3-4]. Besides, physico-chemical properties of the Cu-Sn alloys directly connected with phase evolution. For example, coexistence with hard martensite phase induces excellent mechanical properties in the traditional Cu-Sn alloy. Therefore, it is essential to study on the microstructure evolution of the traditional Cu-Sn alloy containing martensite phases for the fabrication of traditional BangJja-Yuggi and its modification.

Here, we investigated the microstructures of BangJja-Yuggi containing 22 wt.% and 24.6 wt.% Sn respectively. BangJja-Yuggi was fabricated by casting process from melted 78 wt.% Cu and 22 wt.% Sn in SiC furnace at 1350 -1400°C. After that, the casted Cu - 22 wt.% Sn alloy was heat-treated at 775°C followed by rapid quenching in water. The microstructure were identified by real-time X-ray diffraction (HT-XRD; X'pert Pro) and transmission electron microscopy (TEM; Talos F200X).

It was confirmed that Φ#177; phase, ordered β phase, and β martensite phase were produced in the BangJja-Yuggi containing 22 wt.% Sn. And we defined that the crystal structure of β martensite phase was orthorhombic using XRD analysis. However, the martensite phase in the alloy containing 24.6 wt.% was different with that of 22 wt.% Sn. As a result, 24.6 wt% Sn alloy was expected to consist of four phases of ordered β, β martensite, ordered γ and γ martensite phase. The crystal structure of γ martensite phase observed in this study was predicted as hexagonal structure according to TEM analysis.

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