Hardness and Microstructure of Sterling Silver Cast by Sloped Cooling Plate Method

Natthaphol Chomsaeng[1*] and Nuchthana Poolthong[2]

[1]Jewelry Materials Research and Development Unit, Faculty of Gems, Burapha University, Chanthaburi Campus, Chanthaburi 22170, Thailand
[2]Division of Materials Technology, School of Energy, Environment and Materials, King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand

**Corresponding author. E-mail: natthapholc@gmail.com*

https://doi.org/10.12982/CMUJNS.2017.0020

ABSTRACT

Semi-solid casting was introduced to improve the mechanical properties of sterling silver by sloped cooling plate technique. Ag alloys (93.5 wt%) were cast from an induction furnace at 1,000°C onto a sloped cooling plate. The pouring angles and distances were 30-60 degree and 200-250 mm, respectively. Effects of pouring angles and casting distances on hardness and microstructure of the sterling silver were investigated. Then, the solution was treated, followed by quenching and artificial aging. The specimens were checked with Vickers microhardness tester, light microscope, and scanning electron microscope (SEM). Hardness of the as-cast sample from the semi-solid process was 63-78 HV. The 60-minute aged sample that was cast at a 30° angle and 250 mm distance obtained the maximum hardness of 148.5 HV. The microstructure of the as-cast sample consisted primarily of α-phase and eutectic structure. A spheroidal and short dendrite structure was formed in the as-cast sample. After aging, precipitation occurred substantially within the α-phase. SEM images revealed that the aged sample with the highest hardness contained Cu-rich and Ag-rich precipitates in the α-phase.

Keywords: Sterling silver, Semi-solid casting, Aging, Hardness

INTRODUCTION

Market demand for silver jewelry has been increasing, due to its lower price compared to jewelry made of other precious metals. Since pure silver is soft, with a hardness of ~55 HV, it is usually alloyed with 7.5 wt% Cu to create sterling silver (Olver, 2001) with a hardness of 60-70 HV (Chanmuang et al., 2012). Hardening strengthens the alloy. Cu (8.8 wt%) is soluble in silver at 775 °C (Nisaratanaporn S. and Nisaratanaporn E., 2003). The resultant alloy has a microstructure of an alpha phase (α) and a eutectic phase. Adding a third element, such as Zn, Si, Ge, Mn, Ir, or B, can improve their properties and cast ability.