

Accepted Manuscript

Technical note

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PII: S0142-1123(18)30231-7

DOI: <https://doi.org/10.1016/j.ijfatigue.2018.06.017>

Reference: IJF 4721

To appear in: *International Journal of Fatigue*

Received Date: 16 April 2018

Revised Date: 9 June 2018

Accepted Date: 11 June 2018



Please cite this article as: Yang, B., Wu, M., Li, X., Zhang, J., Wang, H., Effects of cold working and corrosion on fatigue properties and fracture behaviors of precipitate strengthened Cu-Ni-Si alloy, *International Journal of Fatigue* (2018), doi: <https://doi.org/10.1016/j.ijfatigue.2018.06.017>

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Effects of cold working and corrosion on fatigue properties and fracture behaviors of precipitate strengthened Cu-Ni-Si alloy

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Abstract In this study, the tensile and fatigue tests were conducted on precipitate strengthened Cu-Ni-Si alloy. The fatigue properties of specimens with cold working and without cold working in air, as well as that of the specimen with cold working in salt atmosphere were investigated. The results show that the monotonic tensile strength and the yield strength are improved obviously, while the elongation decreases by cold working. The S-N curves of all the types of specimens show a continuous decrease. The fatigue strength of specimens in air is slightly reduced by cold working, however, that of the specimen with cold working at 10^7 cycles is largely decreased from 190 MPa to 120 MPa in salt atmosphere. All the fatigue cracks initiate from the specimen surface by slip deformation. In air condition, the specimens with cold working show shear mode fracture with transgranular crack propagation and it is caused by the obvious texture, while that without cold working show normal mode fracture with both transgranular and intergranular crack propagation. However, in salt atmosphere condition, the specimens with cold working show normal mode fracture with totally intergranular crack propagation.

Keywords: Precipitate strengthening; Cold working; Salt atmosphere; Fatigue strength; Fracture behavior

1. Introduction

The precipitation strengthened copper alloys have been developed and applied to engineering structures due to its high strength as well as good electrical conductivity. The Cu-Ni-Si alloy is one of these copper alloys which exhibit good mechanical properties, fatigue and corrosion resistance. It has been widely used for electrical connectors, lead frames, relays and so on. In the past years, numerous studies on Cu-Ni-Si alloy have been performed to investigate the mechanical properties and microstructure evolution [1-5]. The heat treatment [4], processing technique [6, 7]

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