Title

Acoustic Assessment of Microstructural Deformation Mechanisms on a Cold Rolled Cu30Zn Brass

Abstract

The relationship between acoustic parameters and the microstructure of a Cu30Zn brass plate subjected to plastic deformation was evaluated. The plate, previously annealed at 550 °C for 30 min, was cold rolled to reductions ranging from 10% to 70%. Linear ultrasonic measurements were performed on each of the nine specimens, corresponding to the nine different reductions, using the pulse-echo method to record the times of flight of longitudinal waves along the thickness axis. Subsequently, acoustic measurements were conducted to determine the nonlinear parameter (Formula presented.) through second harmonic generation. Microstructural analysis, carried out by X-ray diffraction, Vickers hardness testing, and optical microscopy, revealed an increase in deformation twins, reaching a maximum at 40% thickness reduction. At higher deformations, the microstructure showed the generation and proliferation of shear bands, coinciding with a decrease in the twinning structure and an increase in dislocation density. The longitudinal wave velocity exhibited a 0.9% decrease at 20% deformation, attributed to dislocations and initial twin formation, followed by a continuous increase up to 2% beyond this point, resulting from the combined effects of twinning and shear banding. The nonlinear parameter (Formula presented.) displayed a notable maximum, approximately one order of magnitude greater than its original value, at 40% deformation. This peak correlates with a roughly tenfold increase in twinning fault probability at the same deformation level.

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Year

2024

Source title

Materials

Volume

17.0

Issue

13.0

Art. No.

3321.0

DOI

10.3390/ma17133321

Link

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85198560960&doi=10.3390%2fma17133321&partnerID=40&md5=7ef44899d7e9fe7da1805f4ed7c00f2b

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Author Keywords

brass; nonlinear parameter; nonlinear ultrasonic measurement; second harmonic generation; shear bands; twinning

Index Keywords

Binary alloys; Brass; Cold rolling; Harmonic generation; Metal cladding; Microhardness; Nonlinear optics; Parameter estimation; Plates (structural components); Shear flow; Vickers hardness; Vickers hardness testing; Wave propagation; % reductions; Acoustic assessment; Acoustic parameters; Cold-rolled; Deformation mechanism; Microstructural deformation; Non-linear parameters; Non-linear ultrasonic; Nonlinear ultrasonic measurement; Pulse-echo method;

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Publisher

Multidisciplinary Digital Publishing Institute (MDPI)

ISSN

19961944

Language of Original Document

English

Abbreviated Source Title

Mater.

Document Type

Article

Publication Stage

Final

Source

Scopus

EID

2-s2.0-85198560960