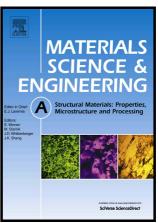
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Tuning of nanostructure by the control of twin density, dislocation density, crystallite size, and stacking fault energy in $Cu_{100-x}Zn_x$ ($0 \le x \le 30wt.\%$)

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Tuning of nanostructure by the control of twin density, dislocation density,

crystallite size, and stacking fault energy in $Cu_{100-x}Zn_x$ ($0 \le x \le 30$ wt.%)

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Abstract

The present study demonstrate the effect of stacking fault energy (SFE) on the evolution of

crystallite size, dislocation density, twin density, stacking faults, and their mutual interactions

during cryorolling in pure copper (SFE 78 mJ/m²) and copper–zinc alloys with varying Zn

content of 10 wt. % (SFE 35 mJ/m²), 20 wt. % (SFE 19 mJ/m²), and 30 wt. % (SFE 14

mJ/m²). The dislocation density, twin density and extrinsic fault probability increases

whereas crystallite size decreases upon cryorolling and with the decrease of SFE.

Accumulation of dislocations at the twin boundaries causes dynamic recrystallization,

promotes grain refinement by forming subgrains inside the twin lamellae. Detail investigation

on the activity of structural defects during cryorolling of Cu/Cu-Zn alloys has been done

through resistivity measurements. Nanoindentation studies have performed to understand the

deformation kinetics of the cryorolled Cu/Cu-Zn alloys with high concentration of structural

defects in term of strain rate sensitivity and activation volume. A micromechanical model has

been used to demonstrate the effect of SFE and the role of structural defects during

nanostructuring at cryogenic temperature.

Keywords: Electron microscopy; X-ray diffraction; Cu-alloy; Nanostructured materials;

Grain refinement; Twinning.

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