Effect of copper and aluminum contents on wire drawing behavior in twinning-induced plasticity steels

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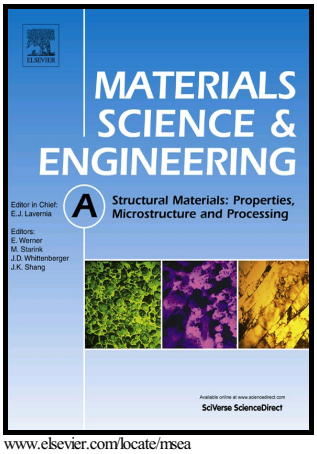

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Effect of copper and aluminum contents on wire drawing behavior in twinning-induced plasticity steels

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Abstract

Wire drawing behavior of the five TWIP steels having a stacking faulting energy (SFE) range of 17-41 mJ/m^2 using different Cu and Al contents has been investigated to improve and predict the drawability in TWIP steels. Cu and Al played similar roles in TWIP steels during wire drawing: increase in drawability and yield strength but decrease in twin formation, strain hardening rate, and tensile strength. However, the effect of Al was higher than that of Cu and the 1.5% Cu addition in TWIP steel had the most excellent combination of strength, ductility, and drawability during wire drawing. The twin volume fraction of all the TWIP steels initially increased and then saturated with drawing strain. The 0CuAl steel had a higher twin volume fraction at all strain levels and saturated earlier than the other TWIP steels due to the low SFE and promoted dynamic strain aging effect, resulting in the earlier fracture of wire. The Al and Cu additions in TWIP steel can tailor the twinning rate with drawing strain and prevent the fast exhaustion of ductility or plastic deformation ability, finally increase the drawability. The reduction of area (RA) of hot rolled TWIP steels had a linear relationship with drawability; therefore, we can predict the drawability of TWIP steels by simply measuring the RA value of hot rolled TWIP steels.

Keywords: Twinning-induced plasticity (TWIP) steel; Wire drawing; Deformation twin; Reduction of area; Drawabiltiy

1. Introduction

Over the past few decades, twinning-induced plasticity (TWIP) steels have received much attention for the structural applications in automotive industries due to their high strength without sacrificing ductility resulting from the extensive deformation twins and/or dynamic