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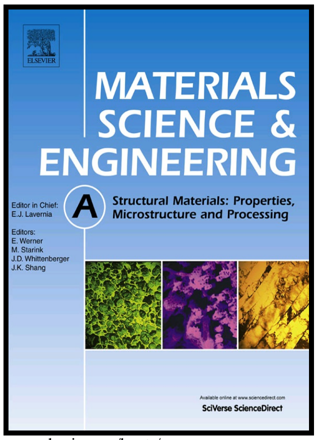

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Mitsuhiro Okayasu, Sai Tomida

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Phase transformation system of austenitic stainless steels obtained by permanent compressive strain

Mitsuhiro Okayasu*, Sai Tomida
Graduate School of Natural Science and Technology, Okayama University, 3-1-1 Tsushimanaka, Kita-ku, Okayama, 700-8530, Japan
*Corresponding author. Tel/fax: +81 86 251 8025. mitsuhiro.okayasu@utoronto.ca (M. Okayasu)

Abstract

In order to understand more completely the formation of strain-induced martensite, phase structures were investigated both before and after plastic deformation, using austenitic stainless steels of various chemical compositions (carbon C = 0.007–0.04 mass% and molybdenum Mo = 0–2.10 mass%) and varying pre-strain levels (0–30%). Although the stainless steels consisted mainly of γ austenite, two martensite structures were generated following plastic deformation, comprising ε and α' martensite. The martensitic structures were obtained in the twin deformation and slip bands. The severity of martensite formation (ε and α') increased with increasing C content. It was found that α' martensite was formed mainly in austenitic stainless steel lacking Mo, whereas a high Mo content led to a strong ε martensite structure, i.e. a weak α' martensite. The formation of α' martensite occurred from γ austenite via ε martensite, and was related to the slip deformation. Molybdenum in austenitic stainless steel had high slip resistance (or weak stress-induced martensite transformation), because of the stacking fault energy of the stainless steel affecting the austenite stability. This resulted in the creation of weak α' martensite. Models of the martensitic transformations γ (fcc) $\rightarrow$ ε (hcp) $\rightarrow$ α' (bcc) were proposed on both the microscopic and nanoscopic scales. The α' martensite content of austenitic stainless steel led to high tensile strength; conversely, ε martensite had a weak effect on the mechanical strength. The influence of martensitic formation on the mechanical properties was evaluated quantitatively by statistical analysis.

Keywords: stainless steel, austenite, strain-induced martensite, model, microstructure

1. Introduction