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Yield stress of duplex stainless steel specimens estimated using a compound Hall–Petch equation

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Abstract In this study, the 0.2% yield stress of duplex stainless steel was evaluated using a compound Hall–Petch equation. The compound Hall–Petch equation was derived from four types of duplex stainless steel, which contained 0.2–64.4 wt% δ-ferrite phase, had different chemical compositions and were annealed at differen temperatures. Intragranular yield stress was measured with an ultra-microhardness tester and evaluated with the yield stress model proposed by Dao *et al*. Grain size, volume fraction and texture were monitored by electron backscattering diffraction measurement. The k_γ constant in the compound equation for duplex stainless steel agrees well with that for γ-phase SUS316L steel in the temperature range of 1323–1473 K. The derived compound Hall–Petch equation predicts that the yield stress will be in good agreement with the experimental results for the Cr, Mn, Si, Ni and N solid-solution states. We find that the intragranular yield stress of the δ-phase of duplex stainless steel is rather sensitive to the chemical composition and annealing conditions, which is attributed to the size misfit parameter.

PACS 81.40.Lm Deformation, plasticity, and creep
62.20.Qp Friction, tribology, and hardness
81.40.Gh Other heat and thermomechanical treatments
81.40.Np Fatigue, corrosion fatigue, embrittlement, cracking, fracture, and failure
62.20.F- Deformation and plasticity
81.40.Ef Cold working, work hardening; annealing, post-deformation annealing, quenching, tempering recovery, and crystallization

Subjects Condensed matter: structural, mechanical & thermal

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