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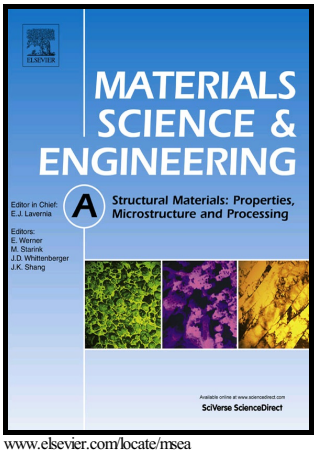

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Measurement and tailoring of residual stress in expanded austenite on austenitic stainless steel

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Abstract

Expanded austenite on stainless steel with a high interstitial nitrogen content is characterized by elasto-plastic accommodation of the large composition-induced lattice expansion leading to huge compressive residual stress. The elasto-plastic accommodation as well as the (steep) concentration profile has implications for the measurement strategy to determine lattice strains and associated residual stresses with X-ray diffraction. Lattice strain measurements were performed on nitrided as well as subsequently de-nitrided expanded austenite on AISI 316L stainless steel, for various grazing incidence angles. It is demonstrated that keeping the information depth constant by choosing appropriate combinations of grazing incidence and tilt angle leads to reliable results for the 111 reflection, while the 200 reflection should be avoided. Further, it is shown for the first time that the residual stresses in expanded austenite can be tailored by de-nitriding after nitriding, such that a condition of virtually zero stress at the surface is obtained.

Keywords: X-ray stress measurement; expanded austenite; nitrogen; stainless steel; residual stress

1. Introduction