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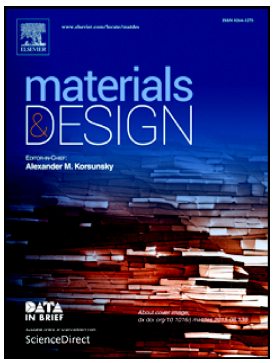

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Strengthening and toughening austenitic steel by introducing gradient martensite via cyclic forward/reverse torsion

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Abstract

Converting austenite to martensite is a very effective and low-cost strategy for steel strengthening, but it results in a significant loss of ductility. In this study, we propose a novel method which simultaneously strengthens and toughens austenitic steels by introducing a gradient of martensite phase. We find that a gradient of deformation-induced martensite (α′-M) particles, with a volume fraction increasing from core to surface can be obtained in cylindrical AISI 304 stainless steel (304 SS) rods by applying free-end-torsion (FET). We compared the microstructures and tensile properties of gradient-structured 304 SS prepared by unidirectional-torsion (UT) and cyclic forward/reverse torsion (CFRT). It appears that piled-up dislocations formed near the core region during FET processing play a key role in the subsequent tensile deformation, and control the strain-hardening ability of the FET treated samples. The gradient α′-M enhances the strength of the surface layer and improves the tensile properties of the FET treated samples as a whole. Compared to UT, CFRT is more

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