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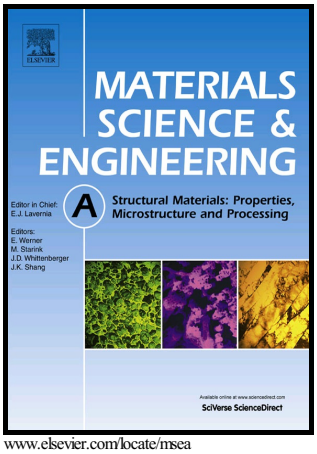

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Overcoming the strength–ductility trade-off via the formation of a thermally stable and plastically unstable austenitic phase in cold-worked steel

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Abstract:

A simple strategy associated with elastic properties that enables metals to undergo multiple plastic deformations based on slip deformation, mechanical twinning, and deformation-induced martensitic transformation was developed in this study. In the Fe–Ni–Al–C alloy designed in this work, the strength and ductility were not in the typical trade-off relationship. The alloy exhibited decreased elongation after strengthening by intermediate amounts of cold working, whereas upon further strengthening, the elongation improved markedly and returned to that in the pre-strengthened state. The tensile behaviors of samples of the alloy indicated that this was due to the thermally stable and plastically unstable austenitic phase that arose after cold working. The microstructures of the samples implied that this austenitic phase stability was due to the occurrence of simultaneous twinning during tensile deformation, and the effect of the plastic accommodation induced by the multiple deformations is discussed in this paper.