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Ultrafine Bainite versus Tempered Martensite in Medium-Carbon Spring Steel: A Micromechanical Comparison of Strain Partitioning

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Abstract

This work contrasts ultrafine bainite and tempered
martensite in a low-alloy medium-carbon spring steel by
probing strain partitioning at the microscale. In situ
tensile tests in a scanning electron microscope, combined
with digital image correlation, are used to measure local strain fields. Ultrafine bainite exhibits more homogeneous deformation and higher work-hardening capacity, whereas tempered martensite shows early localization. The findings are interpreted relative to comparative studies of hardening methods, highlighting conditions where bainitic structures can replace martensitic ones in spring applications without compromising strength.

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