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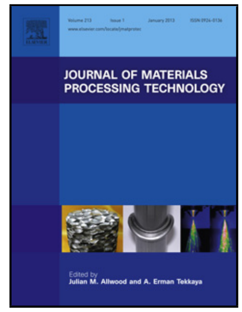

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Microstructure and mechanical properties of fiber laser welded QP980 steel

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Abstract

The fusion zone of laser welded QP980 composed of fully martensitic structure exhibited high hardness (493 Hv). The sub-critical heat affected zone contained partially tempered martensite with a hardness drop (21 Hv). The joints and base metal showed positive strain rate dependent tensile strength, yield strength and energy absorption in dynamic strain rate regime, while elongation responded differently because of thermal softening effect. All the joints failed at base metal showing a typical ductile fracture. Fatigue limit of the joints was lower than that of base metal (171 MPa and 261 MPa, respectively). Fatigue specimens of joints failed at weld area because of their higher sensitivity to stress concentration than base metal. Fatigue crack originated from the specimen surface, and propagated through fatigue striations together with secondary cracks.

Key words: QP steels; Laser welding; Microstructure; High strain rate; Digital image correlation (DIC); Fatigue properties.

1. Introduction

Over the past decade, a significant effort has been focused on developing advanced high-strength steels (AHSSs) to improve fuel economy and increase passenger safety of vehicles. These AHSSs have three generations. As concluded by Moor et al. (2010), the dual-phase (DP), complex phase (CP) and transformation induced plasticity (TRIP) steels are typically low alloyed with ferrite-based multi-phase microstructure referring to as the first generation, which have already been popular for automotive