The evaluation of laser weldability of the third-generation Advanced High Strength Steel

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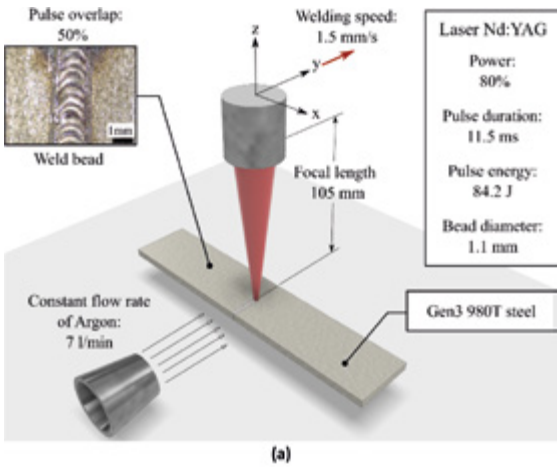
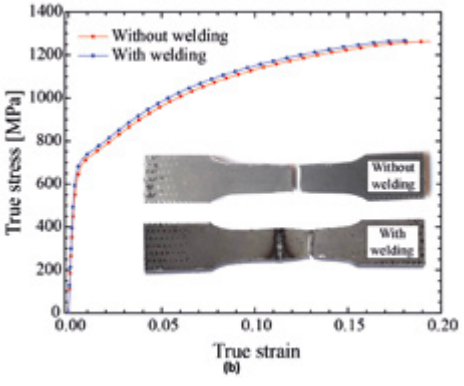
The automotive industry is increasingly using advanced high strength steels (AHSS) in the production of the components to meet the demands of vehicular safety and greenhouse gas emission reduction. With the newly developed third generation of AHSS, it is essential to study their behavior towards manufacturing processes used in the automotive industry. The third generation of AHSS has a cost slightly higher than the first generation and provides mechanical properties between the first and second generation due to its multiphase microstructure with a significant amount of retained austenite. Laser-welding has gained popularity in the metal-joining industry due to its ease of automation and flexibility. Also, the laser-welding has no electrode cap wear as the resistance spot-welding process, not requires access to both sides of the join to support the material as the self-piercing riveting and can also be used to welding dissimilar materials. For this purpose, the welding capability of Gen3 980T steel with 1.58 mm thickness was investigated using the Nd:YAG laser-welding with different parameter conditions. Figure (a) shows the best set of parameters among the analyzed ones for the butt joint welding condition. The analysis was made by uniaxial tensile tests, micro-hardness, Scanning Electron Microscopy, and X-Ray Diffraction. The criteria used to evaluate the quality of the weld were the distance between the fracture and the weld bead and the surface finish. Figure (b) shows the welded specimen of uniaxial tensile test with fracture far from the weld bead and a comparison of its mechanical behavior with the sample without weld. The energy density correspondent to the best set of parameters was equal to 139 J/mm2. It was observed a relationship between the quality of the weld and the energy density. Below the optimal value, partial penetrations were detected. Above the optimal energy density, a high number of spatters and irregularities were perceived in the weld bead.



(a)



(b)

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FIGURE 1
The best set of parameters of Nd:YAG laser welding for the Gen3 980T steel

FIGURE 2
True stress vs. strain curve for Gen3 980T steel, with and without weld.