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Formation of short crack and its effect on fatigue properties of ultrasonic peening treatment S355 steel

Yanyan Feng [a], Shengsun Hu [a], Dongpo Wang [a], Lei Cui [a]
Tianjin Key Laboratory of Advanced Joining Technology, School of Materials Science and Engineering, Tianjin University, Tianjin 300072, People's Republic of China.
Corresponding author: Dongpo Wang
E-mail: wangdp@tju.edu.cn
Fax: +86 022 27405889
Address: Tianjin Key Laboratory of Advanced Joining Technology, School of Material Science and Engineering, Tianjin University, Tianjin 300072, People's Republic of China

Abstract

Samples of S355 steel with different initial surface roughnesses were treated via ultrasonic peening. The micro characteristics and fatigue properties of samples that underwent ultrasonic peening treatment (UPT) were evaluated. Our results indicate that in addition to residual compressive stress, the UPT process might also introduce short cracks, known as fold defects at the surface of metal samples. Fold defects were observed in all samples that underwent UPT, with the extent of the defects depending on both the initial surface roughness of the sample and the UPT time. When UPT time and surface roughness were optimized, the fatigue life was double that of untreated steel. This may be due to the formation of small fold defects and the introduction of compressive stress in the metal. However, long treating times led to a significant reduction in the fatigue life to levels lower than those for untreated samples. We hypothesize that extended UPT times can induce an excess of fold defects with complex morphologies and large dimensions, leading to the formation of cracks where sample failure can occur.

Keywords

Ultrasonic peening treatment, short cracks, fold defects, fatigue properties