纳米压痕法对304不锈钢残余应力的研究

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摘　要：

利用纳米压痕法研究了304不锈钢的残余应力，采用Suresh理论模型恒定载荷时的公式计算残余应力，最大加载载荷依次为500、1000、1500、2000、2500μN。结果表明，不锈钢硬度和弹性模量为定值，退火前后的硬度分别为5.3和4.0GPa，弹性模量分别为110和100GPa。利用Ansys分析软件模拟了压痕过程，发现不锈钢在受压过程中有sink-in现象发生。纳米压痕法测得了未退火不锈钢存在残余压应力，大小为381MPa；用XRD测得了未退火不锈钢中有350±23MPa的残余压应力，两种测量结果吻合良好，说明了纳米压痕法在残余应力测试时的准确性与可靠性。

关键词：残余应力 304不锈钢 纳米压痕法

Study of residual stress in the 304 stainless steel by nanoindentation method

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Abstract:

The residual stress of the 304 stainless steel was investigated by nanoindentation method. The maximum loads were 500, 1000, 1500, 2000 and 2500μN respectively. The Suresh theoretical model was used to calculate the residual stress. Results showed that the hardness and elastic modulus of un-annealed stainless steel are constant. The hardness of un-annealed and annealed stainless steel is 5.3 and 4.0GPa and the elastic modulus are 110 and 100GPa, respectively. Sink-in phenomenon was found during the indentation experiment based on the Ansys software. The compressive residual stress value in the stainless steel (381MPa) was observed and calculated by the nanoindentation method, which is in good agreement with the result obtained by the XRD method (350±23MPa). This agreement demonstrated the accuracy and reliability of using the nanoindentation method for residual stress study.

Keywords: Residual stress 304 stainless steel Nanoindentation

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