Diploma thesis abstract of

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Subsurface residual stress testing in metals with laser pulse excited wideband acoustical waves

Two laser ultrasonic techniques for non-destructive testing of subsurface residual stress in metals are developed in the current work.

First technique is based on laser pulsed excitation of longitudinal acoustical waves pulses and wideband piezoelectric registration of back-scattered from medium heterogeneities acoustical signals. This method is intended for distributed in-depth biaxial residual stress testing. Theoretical background of this technique and numerical modeling, that confirms an accuracy of chosen method are developed. Hardened and grinded nickel and titan samples were investigated at assembled experimental setup.

Another technique is based on laser excitation of surface acoustical Rayleigh waves pulses and intended for in-plane distributed biaxial residual stress testing. New scheme of measurements and calculation algorithm allow one to reach high accuracy of time-of-flight measurements. Detailed analysis of technique's accuracies and opportunities is made in the current work. An influence of surface roughness on Rayleigh waves propagation is also investigated.

Obtained with both techniques results are in a good agreement with control data of mechanical destructive testing. This confirms an accuracy of chosen methods and their availability for application in practice. On the basis of made research work there were formulated principal requirements for laser ultrasonic device for non-destructive testing of residual stress in metals.