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Application of nonlinear laser photoacoustic technique to crack detection

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Nonlinear acoustics is a promising method for non-destructive testing (NDT) as it allows to improve the sensitivity and contrast of defects detection. The application of contactless laser photoacoustic technique for the tasks of nonlinear acoustics looks very promising. Meanwhile, real examples of industrial systems using nonlinear photoacoustics are still absent. In this work nonlinear photoacoustic response of artificially prepared cracks has been studied. Acoustic vibrations have been excited through the loASAHGRcal heating caused by the absorption of a focused beam of visible or near-infrared laser radiation. Several methods have been applied for the detection of surface displacement including piezo-transducers, air-coupled transducers and optical laser interferometry. It has been shown, that nonlinear acoustic response increases drastically when both pump and probe points are localized near the crack. For this reason, the last two methods allowing local probing look very promising. Two dimensional scans of generation and detection points on the sample surface could be used to obtain the images of crack at new spectral components induced by crack nonlinearity. The goal of this work is to find optimal methods of the excitation and detection of nonlinear photoacoustic response of the crack. It should make the technique attractive for the industrial applications.