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Scattering of Rayleigh wave by microcrack with interacting faces

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Scattering of short Rayleigh pulse by a partially closed surface-breaking microcrack is studied both experimentally and numerically. The microcrack was generated by a nonlinear surface wave with shock. In practice such type of cracks corresponds to fatigue or thermally generated ones. The crack was irradiated by a probe laser-generated Rayleigh. The scattered acoustic field at the surface, monitored by means of optical detector, consisted of the reflected and transmitted Rayleigh waves, longitudinal and shear acoustic waves excited by mode-conversions at the crack. Characteristic size of the crack was 50-100 μm, experimental bandwidth was 5-200 MHz. Scattering was simulated numerically in finite differences. For modeling the partially closed crack we proposed a simple one-parameter model, which takes into account weak interaction between the crack faces. It was shown, that interaction changes the predicted frequency-dependent transmission and reflection coefficients significantly. On the basis of fitting the simulated acoustic field to the measured one, the evaluation of the crack size has been performed. In this work frequency dependence of the following three parameters were employed for that purpose: transmission and reflection coefficients, and the time delay of the transmitted pulse. Obtained estimates were compared to the direct microscopic measurement of the crack.