MAR12-2011-001212

Abstract for an Invited Paper
for the MAR12 Meeting of
the American Physical Society

Linear and Nonlinear Laser-Based Guided Acoustic Waves Propagating at Surfaces (2D) and Edges (1D)

PETER HESS, University of Heidelberg

In recent years photoacoustics opened the door to many new applications of 2D linear surface acoustic waves (SAWs), e.g., nondestructive evaluation (NDE) of surface-breaking cracks. Real partially-closed cracks of micrometer size have been analyzed. More recently also pulsed laser excitation of solitary elastic surface pulses and their detection with a continuouswave probe laser has been achieved, by generating dispersion with a thin film coating that introduces a length scale. In addition, such laser-based pump-probe experiments allow the excitation of short nonlinear SAW pulses developing steep shock fronts that fracture brittle materials such as silica or silicon. With this method it is possible to measure the fracture strength of materials and compare the critical failure stress with ab initio calculations of the ideal strength of the corresponding perfect single crystal. The excitation and detection of 1D edge or wedge waves propagating along a wedge formed by two planar surfaces that meet at the apex of the wedge or wedge tip has been performed by laser irradiation. The characteristic features of the non-dispersive linear wedge waves such as their small phase velocity below the Rayleigh velocity, the very high degree of localization of the displacement field at the wedge tip, and their existence for certain geometries in anisotropic media such as silicon could be verified by photoacoustic experiments. Despite the strong nonlinearity of certain edge-localized modes, as expected from theoretical considerations, 1D solitary waves and nonlinear wedge waves with steep pulse profiles could not be detected up to now. The latest progress will be discussed.