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On the optical generation and detection of high frequency ultrasounds : thermal and non-thermal processes

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We report on the results of the generation and detection by femtosecond laser pulses of the acoustic waves at frequencies of tens to hundreds GHz in semiconductors and in oxides compounds exhibiting phase transition. We focus first on the generation mechanisms involved to achieve opto-acoustic transformations. Particular attention will be paid on the cases where classical thermal effects (thermoelastic coupling) drive the mechanism of generation of acoustic phonons and those where non-thermal effects become significant and sometimes dominant sources of acoustic phonons field. In the latter cases, we will specially focus on the phonons generation based on photo-induced modifications of microscopic internal electric fields (potential deformation) and also on the use of photoexcited carriers dynamics (carriers recombination) as a tuning parameter of the photo-generated ultrasounds spectrum. Secondly, we give the examples demonstrating that the choice of optical frequency for ultrasound detection influences not only the amplitude of the detected signal but provides an opportunity to detect separately high or low frequencies in the spectrum of ultrasounds. This study was supported by CPER and ANR project No. BLAN06-3-136284.