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Generation of Acoustic Wavelength Shorter Than 10nm By Means Of Nonlinear Acoustic

Shuo Zhang[a], Emmanuel Péronne[a], Laurent Belliard[a] and Bernard Perrin[a,b]
[a]INSP - UMR 7588 CNRS & Université Pierre et Marie Curie, 140 Rue de Lourmel, 75015 Paris, France
[b]Laboratoire des Milieux Désordonnés et Hétérogènes, Université Pierre et Marie Curie, UMR 7603 CNRS, 4 Place Jussieu, 75252 Paris, France

As the size of the structure decrease toward the nanoscale, their acoustic properties get closer to the THz range. Traditional techniques based on piezoelectric transducer or the Brillouin diffusion can hardly reach the adequate frequency range. However, if we tightly focus short optical pulses, we can expect to generate high frequencies due to nonlinear effect during the propagation of the acoustic pulses. Moreover, such small source could be used to image buried structures. We have developed an pump-probe experiment based on a Ti:Sa oscillator using microscope objectives and 2 axis displacement stage to study nonlinear propagation and diffraction of acoustic wave in 3 dimension. We have studied 356-μm thick GaAs substrate and have demonstrated the generation of acoustic longitudinal wavelength as short as 10 nm. Due to the acoustic dispersion during the propagation, acoustic solitons are observed for high excitation power. Thanks to the use of interferometric detector, the acoustic pulses are characterized in great details. Such experimental development can help us to study the properties of transmission and reflection of buried nanosystem such as single quantum well or phonon nanocavities.