平成 18 年 11 月 10 日

応用物理学会北海道支部　会員各位

応用物理学会北海道支部

講演会のお知らせ

下記講演会を開催いたしますので、多数ご参加下さいますようご案内申し上げます。

演題：Linear and nonlinear laser opto-acoustic measurements in solids from the macro- to the nano-scale
講師：H. A. Schuessler 氏（Texas A&M University, Professor）
日時：平成 18 年 11 月 24 日（金）　16:30～17:30
場所：北海道大学工学部物理工学系大会議室 （A-1-17）
主催：応用物理学会北海道支部

講演の要旨
Recent developments of laser technology provide a unique opportunity to study elastic properties of materials at different scales ranging from centimeters to nanometers. Lasers can be used for the excitation of elastic oscillations as well as for their detection. The arsenal of laser methods includes time-resolved techniques at the femtosecond scale as well as achievement of high stresses in the excitation region close to and above the limit of the mechanical breakdown by a rapid deposition of energy with extremely high specific density. Flexibility of laser opto- acoustic techniques enables investigations of processes and systems that are not easily realizable by other methods. In this talk some examples of these studies will be presented that include measurements with focused and straight-crested surface acoustic waves (SAWs) and femtosecond measurements of acoustic oscillations in nano particles.

We studied the changes of the pulse shape and the phase of the spectral components in converging SAW pulses excited with a femtosecond laser via the thermoelastic mechanism. To produce converging acoustic pulses, the laser beam was focused with an axicon in a circle on the surface of an aluminum sample. The phase absolute value of the spectral components after the passage of the focal region experienced a change close to pi/2 rad (Gouy phase shift). These observations were confirmed by analytical and numerical calculations based on the two- dimensional wave equation for surface acoustic waves.

The nonlinear propagation of very high-amplitude surface acoustic wave (SAW) pulses (Mach numbers about 0.01) in polycrystalline metals, dielectrics and semiconductors was studied.　A nonlinear compression and an increase of the SAW pulse amplitude have been observed. SAW pulses were numerically simulated with a nonlinear evolution equation including local and nonlocal nonlinear terms. As an intense SAW propagates, the temporal evolution of the wave shape provides information on the nonlinear acoustic parameters and the nonlinear elastic constants of the material. The nonlinear propagation of SAW pulses exhibits different types of nonlinear behavior depending on nonlinear acoustic constants.

Recently nanoparticles of different sizes (from few to tens of nanometers) and shapes (spheres, rods, piramids, cages) in solutions and solid crystalline and amourphous matrixes were fabricated and found applications for labeling, manufacturing of materials with engineered optical properties and development of sensors at the single molecule level. The optical, mechanical and thermodynamic properties of nanoparticles are size-dependent and recently the possibility to investigate them with a femtosecond

pump-probe technique exciting confined acoustic oscillations was demonstrated. We will discuss the acoustical and optical properties of nanoparticles obtained with this technique, as well as the possible extension of these studies to the nonlinear regime.

世話人　松田 理
北海道大学大学院工学研究科応用物理学専攻
電話：011-706-7190　omatsuda@eng.hokudai.ac.jp