

Phonons in atomic layer deposited films

Abstract

Phonons are great protagonists in modern physics. They carry a wealth of information on the properties of ionic and covalent compounds, in both bulk and thin-film form. Because of their properties, phonons can also lead to potential applications that have so far been unexploited. In this seminar, I will review the basic physics of phonons and the methods to investigate them, focusing in particular on infrared spectroscopy. I will demonstrate that phonons are very clearly visible in extremely thin-films, and that atomic layer deposition (ALD) can fabricate thin-films that are very suitable for phonon investigation. Next, I will summarize some recent research results describing the ability of phonons to deliver structural and electrical characteristics of thin insulating films. I will focus on rare earth oxide films (in particular Lu_2O_3 and La_2O_3) that have been prepared using ALD as high dielectric constant (high-) gate materials for advanced microelectronic devices. Finally, I will outline some possible new path that could be very promising for research on phonons in thin-films. First I will illustrate the geometry-dependent behavior of phonons in 3D structures and explain how this phenomenon can lead to novel methods to image topography in condensed and soft matter. Then I will focus on the absorptive properties of longitudinal optical phonons, and outline the implications of this property for infrared energy harvesting.