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La soutenance a lieu par visioconférence

Candidat	M. LUO Haoming
Fonction	Doctorant
Laboratoire INSA	LAMCOS
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Composition du Jury

Civilité	Nom	Prénom	Grade / Qualité	Rôle
M.	RUFFLE	Benoit	Professeur des Universités	Rapporteur
M.	VASSEUR	Jérôme	Professeur des Universités	Rapporteur
M.	LIU	Haozhe	Chercheur / Professeur des universités	Examinateur
M.	JACQUET-RICHARDET	Georges	Professeur des Universités	Examinateur
MME	TANGUY	Anne	Professeur des Universités	Directrice de thèse
MME	GIORDANO	Valentina	Docteur - Ingénieur	Examinateur

Résumé

Heat transfer is actually intimately related to the sound propagation (acoustic transfer) in materials, as in insulators and semi-conductors the main heat carriers are acoustic phonons. The concept of the presence of interfaces has been largely exploited for efficiently manipulating phonons from long-wavelength to nanometric wavelengths, i.e., frequencies in THz regime. In this thesis, the finite element method is used to perform transient analysis of wave-packet propagation in different mediums. I started with a parametric study of attenuation of acoustic wave-packets in a 2D semi-infinite elastic system with periodic circular interfaces. Three key parameters are investigated, including rigidity contrast, interface density and phonon wavelength. Different transfer regimes (propagative, diffusive, and localized) are identified thus relating the phonon contribution to thermal conductivity. Besides the circular interfaces, mechanical response and acoustic attenuation for different types of interfaces are also investigated, such as Eshelby's inclusion, dendritic shape inclusion and porous materials with ordered/disordered holes. In order to extend the study to amorphous materials, I also considered a heterogeneous medium with random rigidities distributed in space according to Gaussian distribution based on the theory of heterogeneous shear elasticity of glasses. Finally yet importantly, viscoelastic constitutive laws are proposed to take into account the frequency-dependent intrinsic phonon attenuation in glasses, with the aim that a homogeneous viscous medium can reproduce this intrinsic attenuation. Finite element simulation confirms that a continuum model may strictly follow the atomistic attenuation (Γ) for a well-calibrated macroscopic linear viscoelastic constitutive law. Compared with the experimental data in A-Si2O, our constitutive law reproduces qualitatively and quantitatively the three regimes of acoustic attenuation versus frequency: $\Gamma \propto$ (1) ω^2 (2) ω^4 (3) ω^2.