

NOM de l'entreprise : SAINT-GOBAIN RECHERCHE

Ville et code postal : AUBERVILLIERS - 93303

DESCRIPTIF du thème de recherche proposé (sans aucun caractère confidentiel):

Phonic Heat Transfer in Super Insulating Nanostructured Materials

Thermal insulation is a major lever for the energy consumption reduction in buildings and thus reduction of pollution. A highly efficient thermal insulation can be made with microporous materials, like silica aerogel, without increasing too much the thickness: while the thermal conductivity of air, generally considered as a good thermal insulating medium, is about 25 mW/m/K, at room pressure and temperature, the aerogel's apparent thermal conductivity does not exceed 15 mW/m/K. The small pores' size is responsible of such low thermal conductivity thanks to Knudsen effect. In addition to the reduced air thermal conduction, heat is also transferred through the material by conduction in the solid phase and by radiation. Both may account for about 30% of the overall thermal conductivity, or even more, when microporous materials are used as a core material for vacuum insulated panels. Whereas quite sophisticated models for radiative heat transport in such media have been developed, the solid conduction (phonon's transport) is usually modelled by simple approaches. Recent works¹ on this topic show that the small scale structure influences the phonon's transport. At the micro and nano scales the classical Fourier diffusion law is no more valid: it is necessary to solve the Boltzman's transport equation².

The stake is thus to better include/understand the conduction heat transfer phenomena in such complex, nano-structured materials. This would enable to develop a prediction model of the materials phonic conductivity, and to design optimized nano-structures.

From a theoretical point of view, work will consist first in modelling the phonon mean free path in a spherical particle and in agglomerates; for example using Monte Carlo method. Parameters as porosity, temperature, particles' size, size distribution will be optimized to minimize the solid conductivity. The developed method would be enlarged to the particles and gas mix to highlight the thermal bridges that gas enables between particles.

An experimental approach would also be developed to characterize the materials structure, such as 3D MET technique, and the material thermal conductivity. The measurements will allow validating the prediction model.

Profile:

Graduate of a top level university or technical school (including French Grandes Ecoles)

Preferably with a master in Physics, Heat Transfer, Mechanical Engineering or related fields.

Skills in modelling and numerical methods and experimental skills a plus.

¹ Domingues G., Volz S., Joulain K., Greffet J.J., *Transferts de chaleur entre deux nanocristallites de silice*, Journée SFT Thermique des matériaux nanoporeux, 27 Janvier 2005.

² Randrianalisoa J., Baillis D., *Monte Carlo simulation of steady state microscale phonon heat transport*, ASME Journal of Heat Transfert juin 2008, vol. 130.

Individual should be creative and innovative, with problem-solving mentality and hands-on approach to research. Excellent verbal and written communications skills are required.

Date de recrutement : Quickly available

Adresse email à laquelle le candidat doit répondre: SaintGobain-60071897@cvmail.com