Super insulating materials are generally defined as materials with a thermal conductivity below $25\ mW/(m.K)$ in room conditions. Very recent works have led to the formulation of organic aerogels obtained from cellulose and derivatives as precursors (ANR Nanocel Habisol). The analyses of Scanning Electron Microscope (SEM) pictures, show a porous structure with open-cell (illustration). An approach for estimating the total heat transfer inside these new insulating nanostructured cellulosic matrices has been investigated. The model accounts for the characteristic solid matrix at the nanometric scale by using a representation of the nanostructured and mesoporous internal structure.

The radiation-conduction heat transfer is taken into account. Previous analytical correlation for the fluid phase is used to model the conduction heat transfer in gas. New formulations based on mean free path theory combined with the phonon tracking approach are proposed to model the conduction heat transfer in the solid phase at the nanometric scale. The spectral radiative properties are obtained from Rayleigh scattering approach. These models are useful since they permit to determine conduction-radiation equivalent conductivity as a function of cell dimensions, phonon and optical properties of cellulosic matrix.