Material Parameters Influencing the Radiative Properties of Opaque Ceramics

Hector Gomart, Benoit Rousseau [C], Domingos De Sousa Meneses and Patrick Echegut [S]
CNRS-CEMHTI, Université d'Orléans - Polytech'Orléans, Orléans, France

Knowledge of the thermal radiative properties of porous materials is crucial for the design of efficient systems operating at high temperatures. Examples include thermal barrier coatings, or metallic foams used in heat exchangers. Costly experimental trial-and-error campaigns are often required to elaborate a material endowed with the desired radiative properties. An alternative way to speed up the development of these systems is to model their optical response by taking into account their internal structure according to a multi-scale approach. From a material viewpoint, this task requires for a given compound, to thoroughly characterize its material parameters such as its chemical composition, its texture with relevant morphological descriptors, and its macroscopic size. Here, the term texture stands for the spatial organization and the size distribution of the scatterers (grains, pores) that constitute the architecture of the porous material. In the other hand, from a modeling viewpoint, an important task is to appreciate the magnitude of the optical mechanisms that are connected to the latter material parameters. This investigation is primordial and allows, in return, the development of computing strategies giving reliable radiative data. In this work, a general approach is proposed to treat this tricky issue. It is applied to the case of two ceramic systems based on conducting oxides. The first one is used in the design of plate black body furnaces, and the second one is used as a cathodic layer for SOFC. After characterizing their chemical and textural properties, a strategy of modeling based on a Monte Carlo Ray Tracing code will be detailed. According to the length scale of the scatterers, adaptation of the previous code will be proposed. At least, the pertinence of the computing approach will be discussed by comparing the calculated spectra with the experimental ones acquired with a set-up based on infrared spectrometer Bruker IFS 113 v.