Tuning the spectral emissivity of α-SiC open-cell foams up to T = 1300 K by acting on their macro-porosity.

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Nowadays, α-SiC open-cell foams are intensively studied for developing volumetric solar receivers in solar power towers [1]. The interest for these refractory foams lies on their remarkable thermo-mechanical properties, high solar absorptances and large volumetric areasleading to good volumetric heat transfer coefficients. Knowledge of their thermal radiative properties at their expected operating temperatures (~ 1300 K) that corresponds here to the temperature of air, feeding the gas turbines downstream of the receivers, are mandatory to calculate their solar-to-heat conversion efficiencies. However, numerical codes or analytical expressions being able to compute the efficiencies used only room-temperature radiative data. This situationmay misestimate the true efficiency especially when corrosion phenomena under air (pressurized or not) mayoccur after long time of use. On the other hand, measuring the high temperature radiative properties of open-cell foams required to homogenously heat volumes larger than theirradiative Representative Elementary Volumes that fulfils the so-called beerian regime [2, 3].

To solve this issue, one proposes to use a robust multi length scale numerical approach to calculate the radiative properties of digitalized α-SiC open-cell foams up to 1300 K. A realistic foam generator (GenFOAM, C++) [3] is used to provide 3D meshed images with prescribed textural features (porosity, mean nominal pore diameter…). Then a Monte Carlo Ray Tracing code (iMorphRad, C++) allows the transport of rays within the porous media. At each local event (air/matter), high temperature complex refractive indices [1-200 µm] determined for an heavily doped α-SiC single crystal are then called to partition absorbed and reflected intensities. The complex refractive indiceswere obtained by modelling the emittance spectra [4] with a complex dielectric function model based on the Drude-Lorentz approach. Results will be detailed and discussed. Finally, practical considerations for designing efficient volumetric solar receivers will be given.

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