Non-contact Thermophysical Characterization of Solids and Fluids for Gen3 (#08379)

In-situ near-wall and bulk thermal conductivity measurement of flowing fluid and moving particle bed.

Impact

Obtain accurate *k* of HTFs; *In-situ* measurement of thermal conductivity (*k*) **of flowing fluid** and **moving particles**. Understand thermal transport mechanism of moving HTFs (molten salt and granular flow). Quantify near-wall resistance R_{NW} **and bulk** k_{bulk} **of moving particle**.

Project Goal

Accurate *k* measurement of solid substrates, solar absorbing coatings, stationary molten salts, and particle bed at high temperature. *In-situ k* measurement of moving particle and flowing molten salt in a channel/pipe at high temperature. Understand heat transfer mechanisms in flowing molten salts and moving particles

Method(s)

Modulated photothermal radiometry (MPR) measurement of solid, coating, stationary molten salt, flowing fluid and stationary/moving particle bed up to 700℃. MPR diagnostics of flowing molten salt in a loop. Measurement results are compared with that by laser flash analysis (LFA), transient hot-wire (THW) and DSC.

Outcome(s)

First *k* measurement of solar absorbing coating; First *k* measurement of moving particle bed in a channel; First local *k* and convective HTC measurement of flowing fluid in a tube. *k* measurement of molten salt without convection and creeping effects; On-going non-contact *k* measurement of flowing molten salt (First-of-the-kind). On-going local measurement of R_{NW} and airgap close to wall of moving particle bed (First-of-the-kind).

Conclusion/Risks

Accurate *k* of stationary nitrate and chloride salts up to 700℃; *k* of stationary particle bed from 0.3-0.6 W m^{-1} K^{-1} up to 700℃; *k* of particle decreases by 10-40% when moving; Intrinsic *k* of flowing fluid obtained using MPR. Direct near wall thermal resistance measurement of moving particles.

Team

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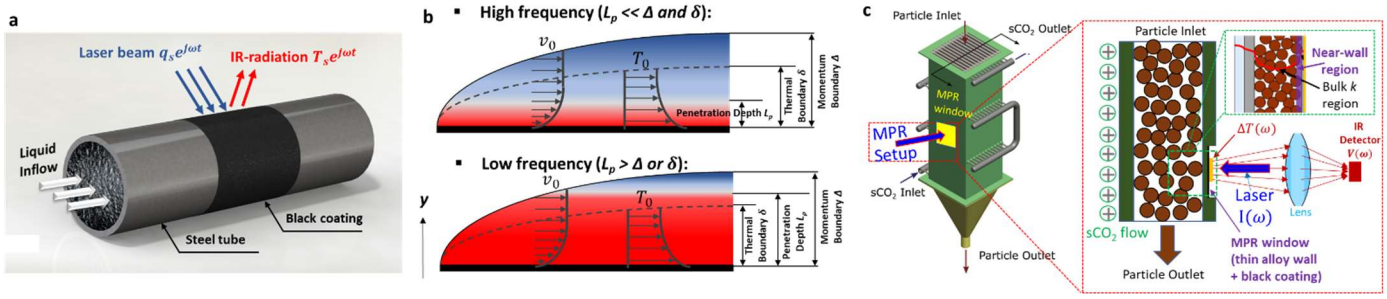

Figure 1. MPR measurement systems. (a)&(b) MPR measurement of flowing fluid in a tube. Intrinsic *k* is obtained at high frequency; (c) MPR measurement on moving particle bed for HEX and separation of R_{NW} and k_{bulk} in a single measurement