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Micro-scale Laser-induced Fluorescence Thermometry for Multiphase Flow in Porous Media

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Multiphase flow in porous media is encountered in many important natural and industrial systems relevant to petroleum, water resources, and environmental engineering. In applications such as thermal recovery and thermal remediation of contaminated soil, heat transfer plays a central role. However, pore scale investigation of heat transfer is hindered by challenges such as complex geometry and lack of optical access. Optically accessible microfabricated 2D porous models, known as micromodels, enable the use of optical diagnostic techniques and have been extensively used for flow in porous media research. In this work, a laser-induced-fluorescence-based thermometry technique is introduced for simultaneous measurement of temperature in two immiscible liquid phases in micromodels. The temperature sensitivity of the fluorescence signal for various dyes are quantified using spectrofluorometric as well as in situ measurements in microchannels. Dye combinations with highest sensitivity are tested in multiphase flow configuration to demonstrate the characteristics of the measurement technique in terms of accuracy, temperature range, as well as spatial and temporal resolution.

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Participation

Online

Primary authors: SIMMONS, Samuel (San Jose State University); PEDRIGAL, Christian (San Jose State University); KAZEMIFAR, Farzan (San Jose State University)

Presenter: SIMMONS, Samuel (San Jose State University)

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