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Instantaneous Optical Wall-Temperature of Vertical Two-Phase Annular Flow BRIAN FEHRING, SIMON LIVINGSTON-JHA, ROMAN MORSE, JASON CHAN, JAMES DOHERTY, COLBY BRUEGGEMAN, GREGORY NELLIS, KRISTOFER DRESSLER, ARGANTHAL BERSON, Univ of Wisconsin, Madison, MULTIPHASE FLOW VISUALIZATION AND ANALYSIS LABORATORY AT UNIVERSITY OF WISCONSIN-MADISON TEAM — We present a non-invasive optical technique for measuring the instantaneous temperature at the inner wall of a flow duct. The technique is used to characterize a fully-developed vertical annular flow of R245fa refrigerant. The test section includes transparent heating windows made of glass coated with fluorine-doped tin-oxide. A 15 mW helium-neon laser is directed through a prism mounted on one of the glass windows and reflected off of the interface between the 150-micron-thick liquid film and the inside wall of the testing section window. The intensity of the laser light reflected at the liquid film-window interface depends on the index of refraction of liquid R245fa, which itself depends on the temperature of the fluid. The intensity of the reflected light is measured using a photodiode and calibrated to a light reflectance model based on the Fresnel equations and Snell's law. Instantaneous temperature data is combined with optical liquid film thickness measurements to calculate the local instantaneous heat transfer coefficient at the wall.

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