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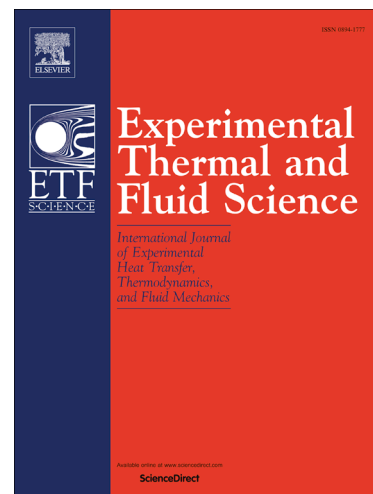
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Experimental study on the performance of capacitance-type meters for slush nitrogen measurement

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Abstract: Slush nitrogen, a cryogenic fluid with solid particles suspended in liquid, is considered a potential coolant for high temperature superconductors. In this study, the capacitance-type meters, which are adopted for measuring the density, liquid level and flow velocity of slush nitrogen, are improved with their accuracy and reliability by optimizing the measurement components and mechanical structure. For density measurement, a capacitance-to-digital converter with high accuracy and resolution is used. The liquid-level-meter is equipped with a coaxial shielding tube, which is earth grounded to protect the electrodes from mechanical disturbance and electromagnetic interference, to strengthen the mechanical support and to improve the stability. The capacitors with double-circular curved-plate electrodes are adopted in the flowmeter to improve its sensitivity. According to the calibration results, the densimeter and the liquid level meter have high sensitivity and good linearity, with improved accuracy of $\pm 0.16\%$ and $\pm 1.0\%$, respectively. Besides, the flow velocity can be calculated from the capacitors' mounting spacing and the delay time of density fluctuation analyzed by cross-correlation function, which turns out to have a relative error within $\pm 7.5\%$ compared with that calculated by the measured variation of liquid level.

Keyword: slush nitrogen; capacitance method; densimeter; liquid level meter; cryogenic flowmeter

1. Introduction

Slush nitrogen is a two-phase mixture with solid particles suspended in liquid, and is considered the potential cooling fluid for HTS (High Temperature Superconductor) [1]. Superior to the liquid

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