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Thermal-wave Resonator Cavity: Modelling and Applications for Water Mixtures

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A novel technique for ultra-high resolution thermal diffusivity measurements of liquid mixtures was developed. In this technique, a thermal-wave cavity containing a liquid sample is utilized. A thermal-wave generator (TWG) and a pyroelectric sensor bound the liquid layer from both sides. The TWG converts the optical energy of a broad modulated laser beam into thermal waves. The induced temperature oscillations are conducted into the liquid and are detected by the sensor producing an output signal. The high sensitivity of the method is due to the exponential dependency of the output signal on the thermal diffusivity of the liquid. To achieve ultra-high sensitivity, we applied a novel signal baseline suppression scheme known as “common-mode rejection demodulation”. Frequency scan experiments with liquid samples were also performed. A theoretical model of the one-dimensional thermal-wave field within the cavity was developed and compared with experiments, showing good agreement.

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