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Dual-Mode Measurement and Theoretical Analysis of Evaporation Kinetics of Binary Mixtures[1] HANYU SONG, Mechanical Engineering, University of Connecticut, CHI-RUEI HE, Chemical Engineering, National Chung Hsing University, CARL BASDEO, JI-QIN LI, DEZHUANG YE, Mechanical Engineering, University of Connecticut, DEVENDRA KALONIA, School of Pharmacy, University of Connecticut, SI-YU LI, Chemical Engineering, National Chung Hsing University, TAI-HSI FAN, Mechanical Engineering, University of Connecticut
— Theoretical and experimental investigations are presented for the precision measurement of evaporation kinetics of binary mixtures using a quartz crystal resonator. A thin layer of light alcohol mixture including a volatile (methanol) and a much less volatile (1-butanol) components is deployed on top of the resonator. The normal or acoustic mode is to detect the moving liquid-vapor interface due to evaporation with a great spatial precision on the order of microns, and simultaneously the shear mode is used for in-situ detection of point viscosity or concentration of the mixture near the resonator. A one-dimensional theoretical model is developed to describe the underlying mass transfer and interfacial transport phenomena. Along with the modeling results, the transient evaporation kinetics, moving interface, and the stratification of viscosity of the liquid mixture during evaporation are simultaneously measured by the impedance response of the shear and longitudinal waves emitted from the resonator. The system can be used to characterize complicated evaporation kinetics involving multi-component fuels.

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