

Abstract Submitted
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Surrogate Immiscible Liquid Solution Pairs with Refractive Indexes Matchable Over a Wide Range of Density and Viscosity Ratios¹
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Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign — Use of laser diagnostics in liquid-liquid flows is limited by refractive index mismatch. This can be avoided using a surrogate pair of immiscible index-matched liquids, with density and viscosity ratios matching those of the original liquid pair. We demonstrate that a wide range of density and viscosity ratios is accessible using aqueous solutions of 1,2-propanediol and CsBr (for which index, density, and viscosity are available), and solutions of light and heavy silicone oils and 1-bromooctane (for which we measured the same properties at 119 compositions). For each liquid phase, polynomials in the composition variables were fitted to index and density and to the logarithm of kinematic viscosity, and the fits were used to determine accessible density and viscosity ratios for each matchable index. Index-matched solution pairs can be prepared with density and viscosity ratios equal to those for water-liquid CO₂ at 0°C over a range of pressure, and for water-crude oil and water-trichloroethylene, each over a range of temperature. For representative index-matched solutions, equilibration changes index, density, and viscosity only slightly, and chemical analysis show that no component of either solution has significant interphase solubility.

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