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Quantitative Viscosity Field Measurement during Viscous Fingering by Imaging Fluorescence from a Viscosity-Sensitive Molecular Probe BRADLEY DICE, MICHAEL RAWAT, SIMONE STEWART, PATRICK BUNTON, Department of Physics, William Jewell College, Liberty, MO, FABIAN BRAU, ANNE DE WIT, Nonlinear Physical Chemistry Unit, Université Libre de Bruxelles, Bruxelles, Belgium, JOHN POJMAN, Department of Chemistry, Louisiana State University, Baton Rouge, LA — The two-dimensional spatio-temporal distribution of the viscosity field has been measured quantitatively during radial displacements of pure glycerol and a miscible solution of glycerol and water inside a horizontal Hele-Shaw cell. Ultraviolet-excited fluorescence from the viscosity-sensitive molecular probe Auramine O was imaged in situ during the displacement. Fluorescence intensity as a function of viscosity was calibrated using known values of viscosity for glycerol-water solutions from the literature. From this calibration, the two-dimensional spatio-temporal map of fluorescence allowed for reconstruction of the evolution of the viscosity field during either the stable displacement or the viscous fingering process. For the stable case the viscosity profile was compared to the known analytical solution. This technique should prove widely applicable for in situ viscosity measurements during flow instabilities subject to appropriate choice of molecular probe.

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