Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

The Role of Chemical Reactions in Fluid Instabilities: Step-Growth Polymerization[1] SIMONE STEWART, DANIELA MARIN, PATRICK BUNTON, Department of Physics, William Jewell College, Liberty, MO U.S.A. — Fingering is a fluid instability that occurs when a fluid of high mobility displaces a fluid of lower mobility. When the source of mobility difference is viscosity, viscous fingering occurs. Schlieren imaging is used to view viscous fingering during step-growth polymerization of various dithiol-di-acrylate systems in a Hele-Shaw cell. A dithiol is flowed into various diacrylates of varying viscosity. Systems are characterized in terms of the Damköhler number (D_a), which is the ratio of the chemical time scale to the hydrodynamic time scale. The reaction rate is tuned by varying the kind and amount of initiator and the flow rate is easily varied with a syringe pump. As a result of these variations, it is possible to gain some degree over control of the fingering that occurs. Results have shown the effects of a low flow rate on a low concentration monomer are comparable to the effects an increase in reactivity has on a flow run at a high rate. Due to the sensitivity of the Schlieren technique and the instability of viscous fingering, gravitational instabilities within the monomer flows are also revealed in this experiment. These are discussed in terms of recent three-dimensional calculations in the literature.

[1]Supported by the National Science Foundation CBET 1335739

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Date submitted: 22 Jul 2015 Electronic form version 1.4