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Simultaneous fingering, double-diffusive convection, and thermal plumes derived from autocatalytic exothermic reaction fronts[1] MATTHEW W. ESKEW, JASON HARRISON, REUBEN H. SIMOYI[2], Portland State University — Oxidation reactions of thiourea by chlorite in a Hele-Shaw cell are excitable, autocatalytic, exothermic, and generate a lateral instability upon being triggered by the autocatalyst. Reagent concentrations used to develop convective instabilities delivered a temperature jump at the wave front of 2.1 K. The reaction zone was 2 mm and due to normal cooling after the wave front, this generated a spike rather than the standard well-studied front propagation. The reaction front has solutal and thermal contributions to density changes that act in opposite directions due to the existence of a positive isothermal density change in the reaction. The competition between these effects generates thermal plumes. The fascinating feature of this system is the coexistence of plumes and fingering in the same solution which alternate in frequency as the front propagates, generating hot and cold spots within the Hele-Shaw cell, and subsequently spatiotemporal inhomogeneities. The small ΔT at the wave front generated thermocapillary convection which competed effectively with thermogravitational forces at low Eötvös Numbers. A simplified reaction-diffusion-convection model was derived for the system. Plume formation is heavily dependent on boundary effects from the cell dimensions.

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