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Magnetic field effects on convective instability of autocatalytic fronts MANORANJAN MISHRA, Indian Institute of Technology Ropar, 140001 Ropar, India, ANDRE THESS, Ilmenau University of Technology, 98684 Ilmenau, Germany, ANNE DE WIT, Université Libre de Bruxelles, 1050 Brussels, Belgium
— The coupling between autocatalytic chemical reactions and diffusion can lead to traveling fronts whereby products invade fresh reactants at a constant speed. The properties of these reaction-diffusion fronts have been studied in details experimentally in gels used to avoid any convective motions. In absence of gels, the dynamics can be perturbed by buoyancy-driven convective flows related to density changes across the front. Experiments have shown that magnetic fields can modify such convective dynamics of traveling fronts. In this context, we study theoretically the influence of a magnetic field on the density fingering pattern of such a reaction-diffusion-convection system. The magnetization is oriented perpendicularly to the plane in which the front travels. The solutions of both products and reactants are assumed diamagnetic (i.e. negative magnetic susceptibility). The influence of the magnetic field is analyzed by numerical simulations of the reaction-diffusion-convection equations for the concentration of the autocatalytic product coupled to Darcy's law for the flow velocity through a concentration dependent magnetic force. We show that the magnetic field is able to suppress or enhance the convective instability depending on the value of the magnetic Rayleigh number of the problem.

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