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Instabilities driven by diffusio-phoretic flow on catalytic surfaces YIBO CHEN, KAI LEONG CHONG, LUOQIN LIU, ROBERTO VERZICCO, DETLEF LOHSE, University of Twente, PHYSICS OF FLUIDS TEAM — The solutal concentration gradient along a surface can induce a diffusio-phoretic flow. Here we theoretically and numerically investigate the instability driven by diffusio-phoretic flow. The important control parameter is the Péclet number Pe, which quantifies the ratio of the solutal advection rate to the diffusion rate. We first study the diffusio-phoretic flow on a catalytic plane by two-dimensional simulations. We have found that when $Pe > 8\pi$, the mass transport by convection overtakes that by diffusion, and a symmetry-breaking mode arises. When $Pe > 16\pi$, multiple concentration plumes are emitted from the catalytic plane, which eventually merge into a single larger one. When Pe is even larger ($Pe > 603$ for Schmidt number $Sc = 1$), there are continuous emissions and merging events of the plumes. Finally, we conduct three-dimensional simulations for spherical catalytic particle, and again find continuous plume emission and plume merging. Our results help understand the chaotic motion of catalytic particles in the high Pe regime.

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