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Haines jumps of bubble in constricted capillary tube WEN DENG, Missouri University of Science and Technology, CHAO ZENG, Missouri University of Science and Techn — When gas bubble passes the narrowest part of constricted tube, the bubble could present impulsive motion. This bursting event is called Haines jump. Even though the Haines jump of bubble in porous media is observed through kinds of advanced imaging approaches, the mathematical model of Haines jump is highly in demand. In this study, a mathematical model is proposed to describe the dynamic motion of bubble passing through constricted capillary tube. A moving-boundary control volume concept is used to establish the dynamics of upstream and downstream incompressible fluids. In this way, the dynamics of bubble can be quantified by the trajectory of two menisci. The mathematical model highlights the importance of Ohnesorge number, bubble length and injected capillary number on the extent of Haines jump. The crossover between spontaneous and slow Haines jump is identified in the analytical model. In spontaneous Haines jump, bubble exhibits impulsive motion and overshoots its equilibrium position. The inertia force dominates in this regime. In slow Haines jump, bubble exhibit oozing motion and sluggishly pass the constriction. The viscous force dominates in this regime. In addition, this theory is compared with existing method and shows remarkable advances. The mathematical model is validated with experiments at constant flow rate boundary condition as well. This theory advances the understanding of Haines jump of bubble and provide insights on controlled flow for targeted delivery in porous media.

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