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# Bubble growth and induced flow characteristics in porous media under heating conditions

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The release of trapped bubbles from dead-end porous media filled with nonvolatile liquid holds extensive applications in gas–liquid reactors, CO2-assisted srteam flooding, ceramic sintering, and droplet microcarriers. Since traditional pressure-driven flow fails to induce bubble transport in dead-end pores, this study investigates the potential use of heating to control the release of bubbles from dead-end porous media. This study addresses the issue of bubble retention in dead-end porous media and designs various microfluidic chips with different porous structures, including upward sparse and downward dense, upward dense and downward sparse, and isotropic porous media. The porosity of the sparse and dense regions is 0.7355 and 0.8718, respectively. Using CO2 as the gas and dimethyl silicone oil as the liquid, a self-built Micro-PIV visualization experimental system is employed to investigate the influence of porous media pore structures on the growth and release of bubbles, as well as the induced flow field patterns under heating conditions. The results show that an increase in temperature leads to the transfer of dissolved gas to the bubble, resulting in an increase in bubble pressure, which serves as the driving force for the bubble to pass through the pore throat. Under heating conditions, changes occur in the surface tension of the gas-liquid interface and the viscosity of the liquid phase, while capillary pressure is a key factor for the bubble to pass through the channel. Blockage occurs when the bubble interface capillary pressure is less than the threshold pressure and breakthrough happens when it is greater. The structure of porous media with dense upper and sparse lower regions impedes bubbles from entering low porosity zones, reducing the coalescence probability. Conversely, the structure with sparse upper and dense lower regions increases the coalescence probability, facilitating bubble expulsion. When bubbles seal pores, their continuous growth causes the liquid velocity of corner film flow to rise. During bubble release, the surrounding liquid accelerates to fill the original space, causing a simultaneous transition that induces vortices along the microcolumn walls.

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## References

## Conference Proceedings

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