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Bubble Breathing during Dissolution in Confined Geometries under Partial Wetting KE XU, Massachusetts Institute of Technology, AMIR PAHLAVAN, Princeton University, RUBEN JUANES, Massachusetts Institute of Technology — One expects that, during the dissolution of a gas bubble into surrounding liquid, the bubble volume will decrease monotonically as a result of continuous mass loss. This intuitive picture, however, changes in a surprising way when the dissolving bubble is confined in a geometry under partial wetting to the gas and the liquid. We show that the bubble then experiences cycles of volume expansion ("inhaling") and shrinkage ("exhaling"), until it fully dissolves. This bubble "breathing" is the result of condensation, growth and merging of liquid droplets on the gas-solid surface, and their eventual expulsion from the gas bubble. Theoretical analysis shows that these counter-intuitive dissolution dynamics are driven by a reduction in the system's free energy. We provide a scaling argument that identifies the transition from this intermittent expansion-shrinkage "breathing" regime and the classical shrinkage-dominated regime. This behavior could play a major role in determining the macroscopic mass-transfer dynamics in partially wetting systems under confinement, such as oxygen transfer in low-temperature fuel cells and enhanced hydrocarbon recovery in porous rocks.

Ke Xu
Massachusetts Institute of Technology

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