MAGNETIC RESONANCE IMAGING OF STRUCTURE AND COARSENING IN THREE-DIMENSIONAL FOAMS

Abstract

by

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The rate of growth of individual bubbles in three-dimensional liquid foams (and crystallites in polycrystalline metals) is a major unsolved problem in material science. We have used Magnetic Resonance Imaging (MRI) to observe non-destructively the structure of disordered liquid foams. Volumetric imaging of coarsening foams required a robust imaging method with sufficient spatial and temporal resolution to resolve the small liquid accumulations in the foam's Plateau borders. We have developed an MRI technique to optimize the image quality for foams with very low liquid fraction. The series of three-dimensional images we acquired provides unique insight into the evolution of foams over up to four days of evolution. Automated computerized analysis provides bubble locations, sizes, and the number of faces per bubble. We tracked individual bubbles between data runs to determine that the volume rate of change of a bubble as a function of its number of faces agrees with Glazier's proposed growth law for three-dimensional grains. Manual extraction of vertex locations for several hundred bubbles provided exact bubble shapes and sizes, as well as the relation between a bubble's number of faces and volume.