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How do bubbles grow in a weakly supersaturated solution? OSCAR ENRIQUEZ, CHAO SUN, DETLEF LOHSE, University of Twente, ANDREA PROSPERETTI, Johns Hopkins University/University of Twente, DEVARAJ VAN DER MEER, University of Twente — Beer, champagne and soft-drinks are water-based solutions which owe their "bubbliness" to a moderate degree of carbon dioxide supersaturation. Bubbles grow sequentially from nucleation sites due to solute concentration gradients and detach due to buoyancy. The leading mass transfer mechanism is diffusion, but the advection caused by the moving surface also plays an important role. Now, what happens at the limit of very weak supersaturation? We take an experimental look at CO_2 bubbles growing in water under such a condition. Nucleation sites are provided by hydrophobic micro-cavities on a silicon chip, therefore controlling the number and position of bubbles. Although advection is negligible, measured growth rates for an isolated bubble differ noticeably from a purely diffusive theoretical solution. We can explain the differences as effects of the concentration boundary layer around the bubble. Initially, its interaction with the surface on which the bubble grows slows the process down. Later on, the growth rate is enhanced by buoyancy effects caused by the depletion of the solute in the surroundings of the bubble. When neighboring bubbles are brought into play they interact through their boundary layers, further slowing down their growth rates.

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