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History effects on the diffusion-driven growth and dissolution of a gas bubble JAVIER RODRIGUEZ-RODRIGUEZ, Carlos III Univ. Madrid (UC3M), MIGUEL A. PARRALES, PABLO PEÑAS, UC3M, OSCAR ENRIQUEZ, Univ. of Twente, ELENA IGUALADA-VILLODRE, UC3M, DEVARAJ VAN DER MEER, Univ. of Twente — A bubble of a gas that is soluble in the surrounding liquid may grow or dissolve depending on whether the saturation concentration at the bubble's pressure is lower or higher than the gas concentration in the bulk liquid. In the limit of small Peclet, the (slow) diffusion-driven bubble growth or dissolution rates are commonly calculated using the Epstein-Plesset theory, despite the fact that it is only valid when the gas concentration field in the liquid is initially uniform. Here we show how to modify this theory to account for non-uniformities in the initial concentration field resulting from the past history of variations of the ambient pressure. In particular, we obtain a history term that closely resembles the Basset memory integral found in the unsteady translation of a sphere through a viscous fluid. The new formulation is applied to the particular example of a bubble, initially in diffusive equilibrium with the ambient, that is subjected to a depression and a later compression. The results are compared to numerical simulations as well as experiments. Funded by the Spanish Ministry of Economy and Competitiveness through grant DPI2011-28356-C03-02.

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