Growth of a viscous microbubble near a chemically-active surface

(in collaboration with St Gobain Research)

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In many different applications, microscopic gas bubbles form and grow near a solid surface where a dissolved gas is released either through chemical reactions, electrolysis or diffusion, and a saturation concentration is reached locally. The growth and motion of the bubble is then controlled both by the diffusion of the dissolved gas and the bubble dynamics under the combined effects of hydrodynamic stresses and buoyancy or local confinement [1]. This process is responsible for several designs of synthetic micro-robots, so-called “micro-rockets”. It also occurs during the industrial production of glass and can significantly impact the mechanical and/or physical properties of the final product.

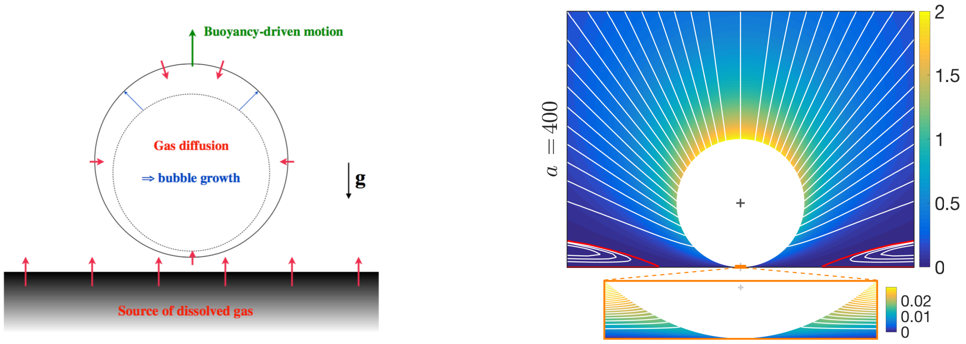

FIGURE 1 – (Left) Bubble growth is induced by the diffusion of dissolved gas from the chemically-active wall to the saturated bubble. The growing bubble then rises under its own buoyancy. (Right) Hydrodynamic flow field around a growing bubble near a rigid wall (colors indicate the velocity magnitude and the inset shows the streamlines within the lubricating film) [2].

This project, which will be supported by and managed in collaboration with St Gobain Research, will analyze the complex and coupled dynamics of the diffusing gas and of the hydrodynamic flow. In a recent work, focusing solely on the hydrodynamic problem, we demonstrated how the nature of the bubble surface can critically control the drainage and dynamics of the liquid film separating the bubble from the active wall [2]. The present project will build on this knowledge to include the coupling to the physico-chemical problem and characterize different dynamical regimes.

This project can potentially be continued as a PhD project at LadHyX.

References

[1] G. Gallino, F. Gallaire, E. Lauga & S. Michelin, 2018 : Physics of bubble-propelled microrockets, *Adv. Funct. Mat.*, **28**, 1800686

[2] S. Michelin, G. Gallino, F. Gallaire & E. Lauga, *J. Fluid Mech.*, 2019, **860**, 172-199.