ME-446 Liquid-Gas Interfacial Heat and Mass Transfer

Homework 9

Presentation by Group 9 on Thursday 21st November

Problem 1: Wicking model and flow boiling

Reproduce Figure 10 in Zhu et al. 2016 with your own code and explain how the wicking velocity is related to the flow boiling in this paper.

Problem 2: Bubble coalescence

Consider two bubbles, both with radius r, initially isolated, with contact angle = 0°. If they merge into a bigger spherical bubble while conserving the volume (also with contact angle = 0°). Calculate the surface energy change of the system, assuming the liquid-bubble interface has a surface tension of γ.

Problem 3: Air bubble in oversaturated liquid

Consider a spherical-cap-shaped air bubble in water with contact line diameter d (see Figure 1). The system is oversaturated with the far-field air pressure denoted as P_0 and the dissolved air concentration in the bulk fluid far from the bubble given by c_∞. The solubility of air in water is characterized by Henry's constant K_H, and the surface tension of the water-air interface is γ.

In equilibrium, assuming there is no gas concentration gradient in the liquid, express the gas-side contact angle θ as a function of the other parameters given in the problem.

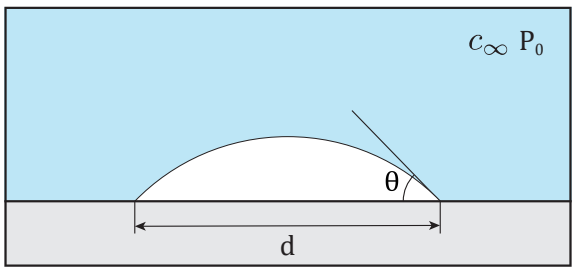

Figure 1: Spherical-cap-shaped surface air bubble in water.