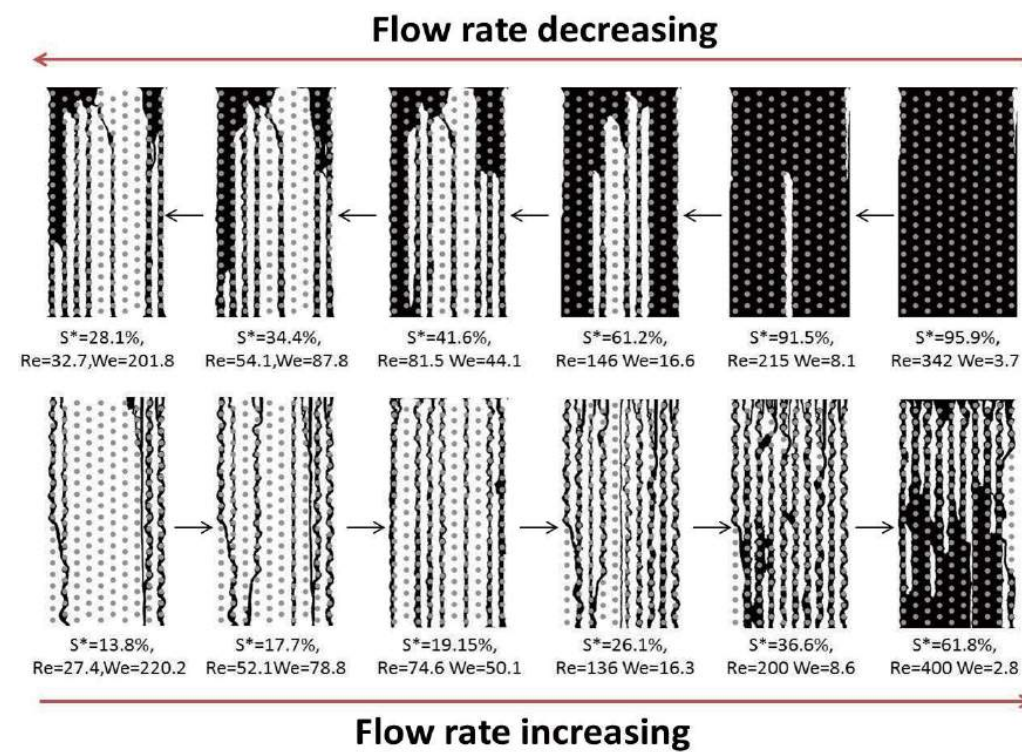
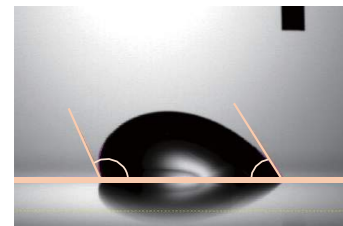
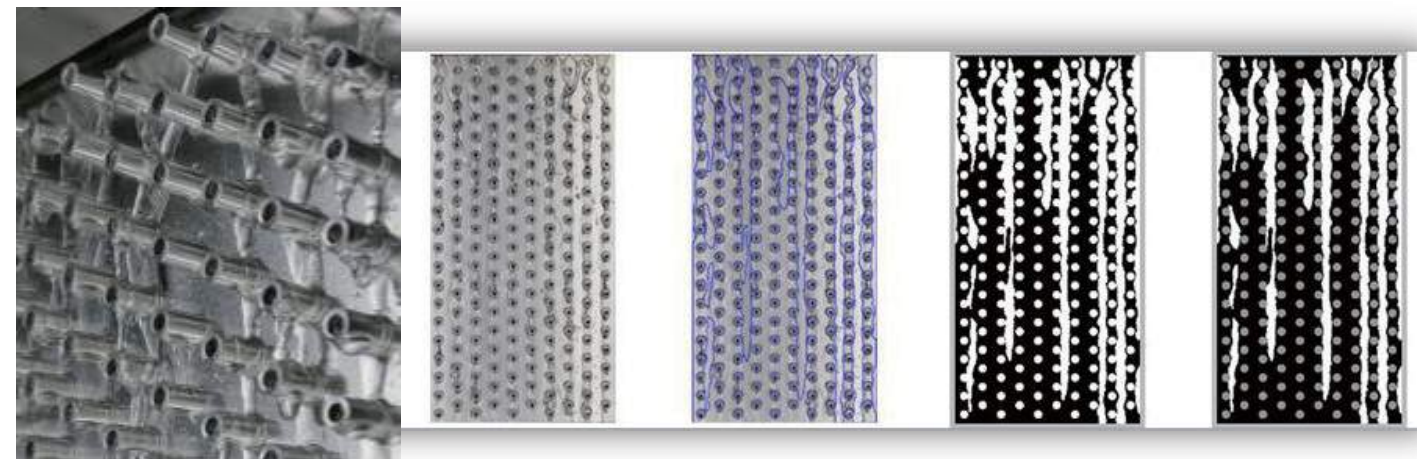
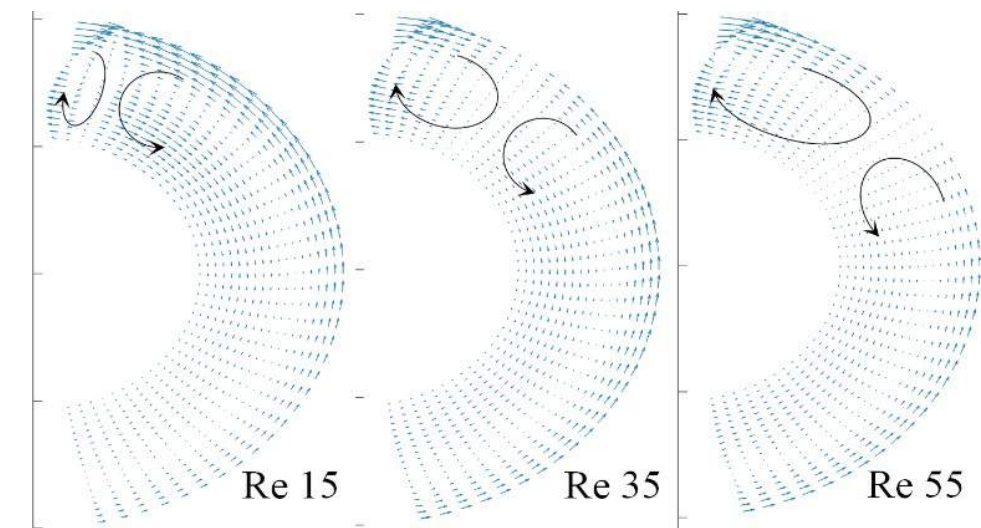
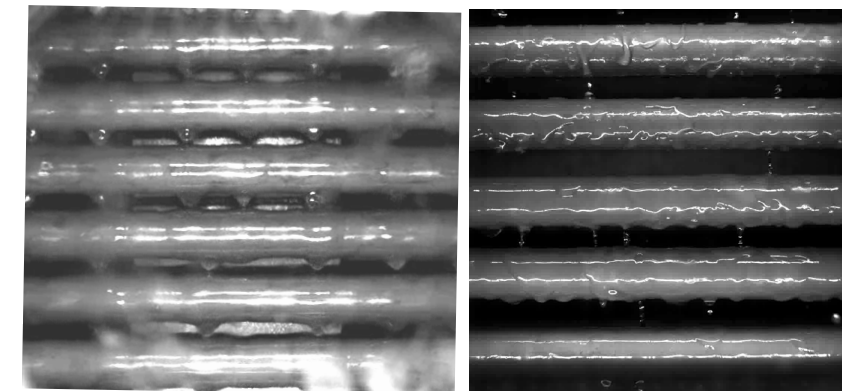


基礎研究③ 可視化とモデリング

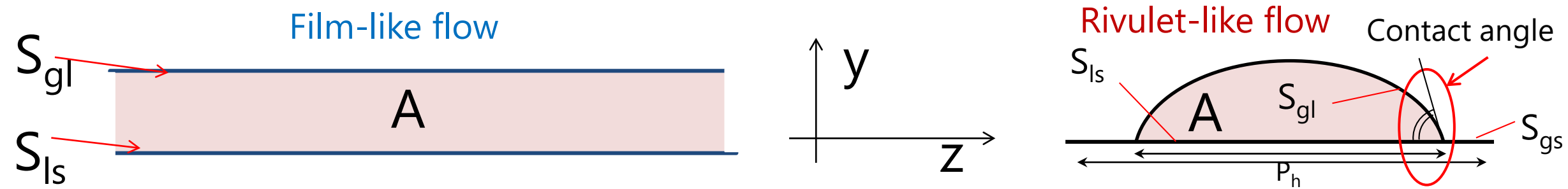
流下液膜式熱交換器の流動の可視化と
そのフィルムブレーキングメカニズムの解明



マランゴニ対流の発生による
流下液膜式熱交換器の伝熱促進



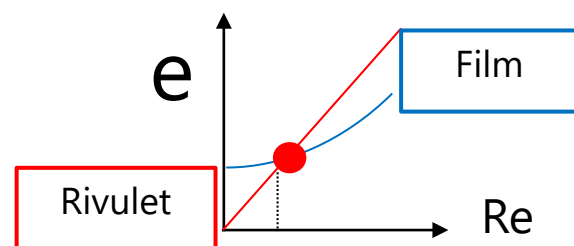
基礎研究④ 可視化とモデリング



Energy of the flow = Kinetic energy + Surface tension energy

A : Cross-sectional area of film · rivulet
 S : Interfacial area of film · rivulet
 dx : unit length in the flow direction

$$E = (e_k + e_s) dx = \left(\int_A \frac{1}{2} \rho u^2 dA + \int_S \sigma dS \right) dx$$



Film breaking

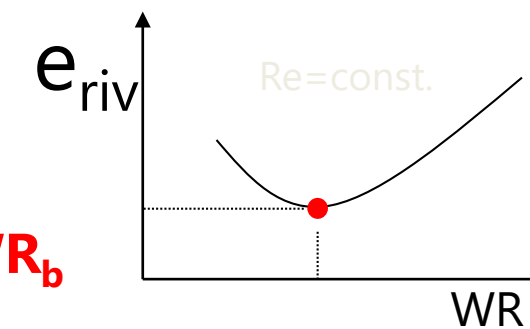
$$e_{riv} = e_{uf}$$

The principle of minimum energy gives the wet part of the solid surface

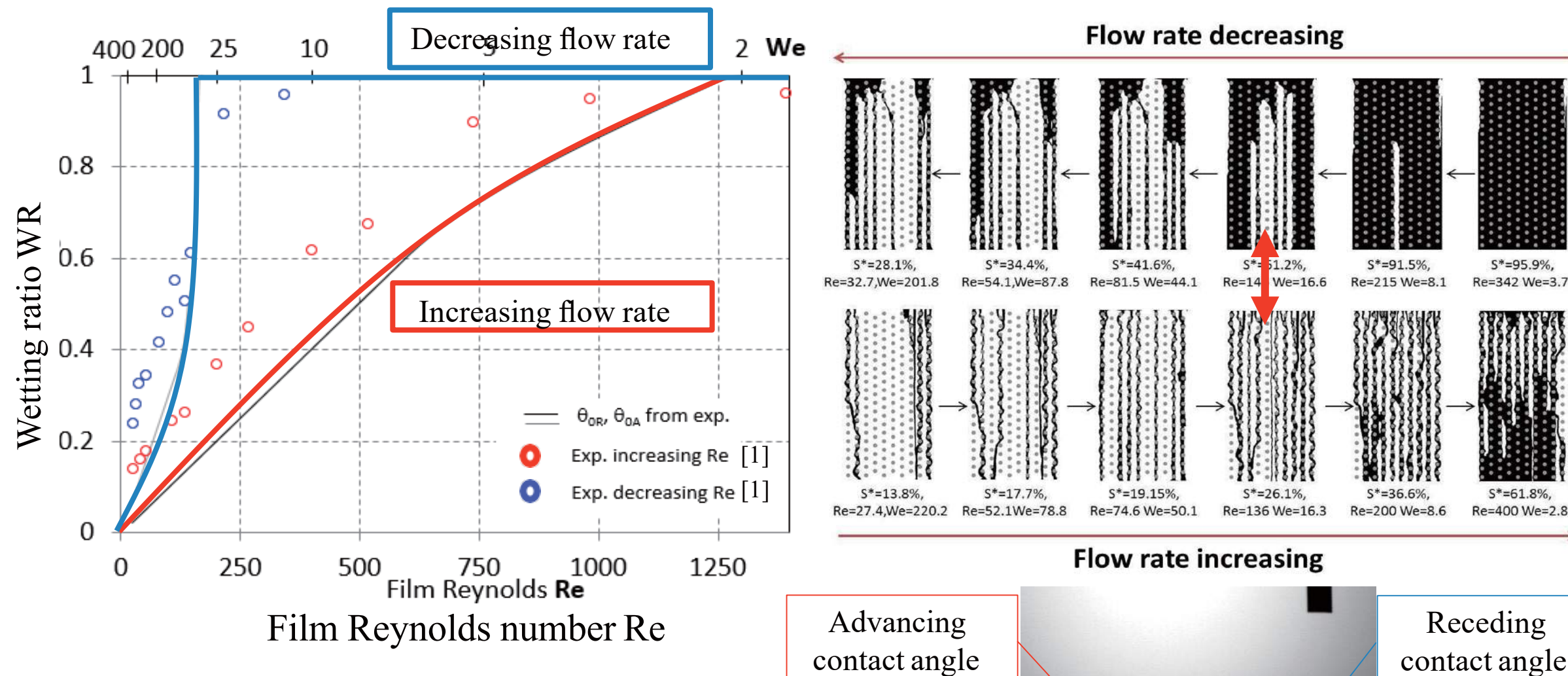
$$WR = \frac{2R \sin \theta_0}{P_h} \quad \frac{\partial e_{riv}}{\partial WR} = 0; \quad \frac{\partial^2 e_{riv}}{\partial WR^2} > 0; \quad WR \leq 1$$

For a given Reynolds number the energy is minimized for WR_b

$$WR_b = \left\{ \frac{2 \psi(\theta_0)}{5 \sin \theta_0} \left[\frac{\theta_0}{\sin \theta_0} - \cos \theta_0 \right]^{-1} \right\}^{3/5} \frac{\sin \theta_0}{\gamma(\theta_0)} \left(\frac{3 \text{Re}}{4 We^3} \right)^{1/5}$$



基礎研究④ 現象の数値解析



The wetting hysteresis behaviour is highlighted

[1] Y. Kobayashi, N. Giannetti, S. Yamaguchi, K. Saito, H. Nakayama, Y. Miyaoka, "Visualization of Falling film on outer surface of fin-tube heat exchanger", 冷凍2015年10月号 第90巻第1056号特集. (in Japanese)