

**Figure 1**

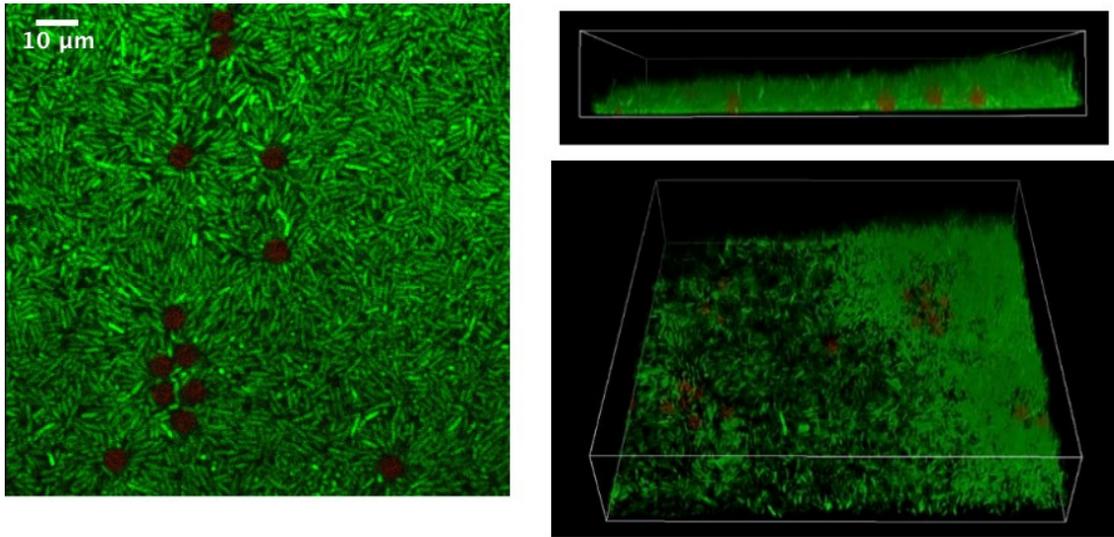


Figure 1. Typical CLSM images of a *P. aeruginosa* biofilm grown after 5 days at a flow rate of 1 mL/h ( $Re= 0.28$ ). Cells appear as green, and the microbeads as red.

**Figure 2**

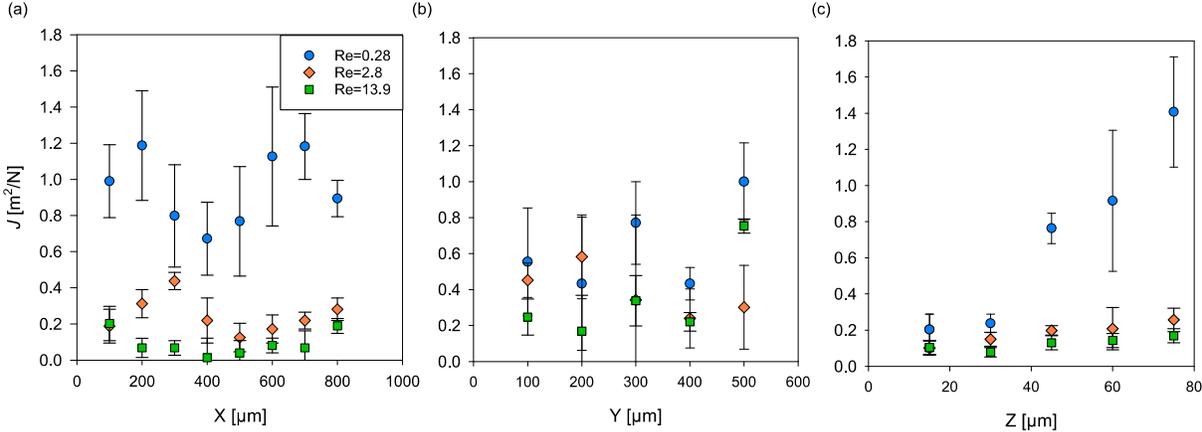


Figure 2. Spatial distribution of the average elastic compliance  $J$  for biofilms grown under different medium flow rate after 5 days. (a) Compliance distribution across capillary width; (b) compliance distribution across capillary length; (c) compliance distribution across biofilm depth. DO was 8 mg/L. For comparison purposes a same biofilm thickness is shown. Error bars are the standard deviation for four replicates.

Figure 3

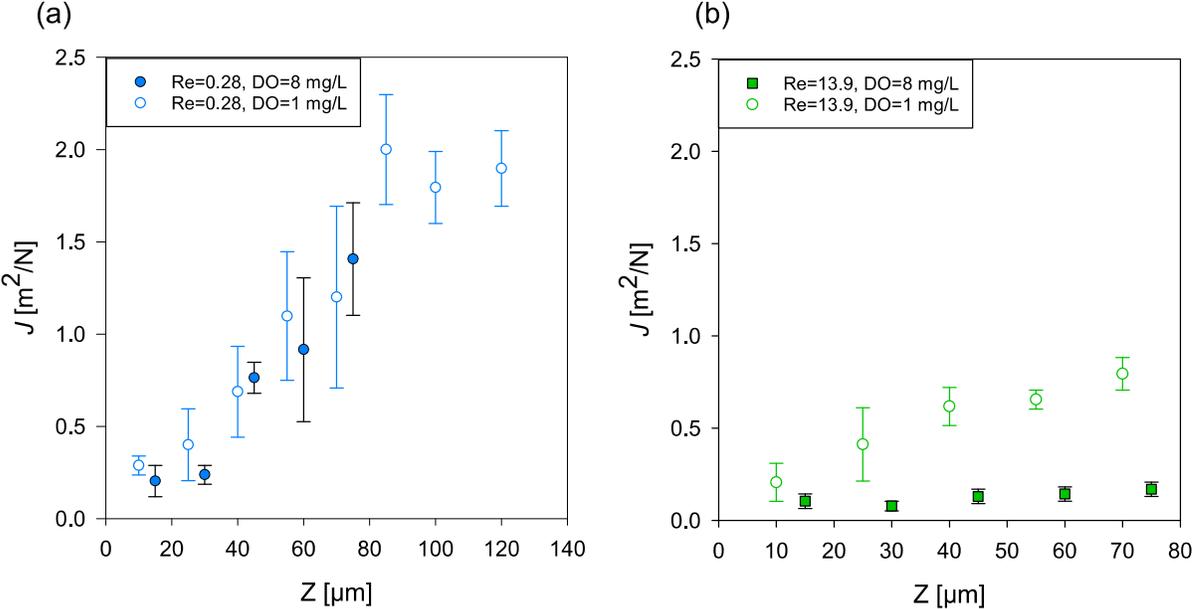


Figure 3. Vertical distribution of elastic compliance in biofilms grown at low DO concentration (1 mg/L) and DO saturation (8 mg/L) at different medium flow rate after 5 days. (a)  $Re=0.28$ ; (b)  $Re=13.9$ . Error bars are the standard deviation for four replicates.

**Figure 4**

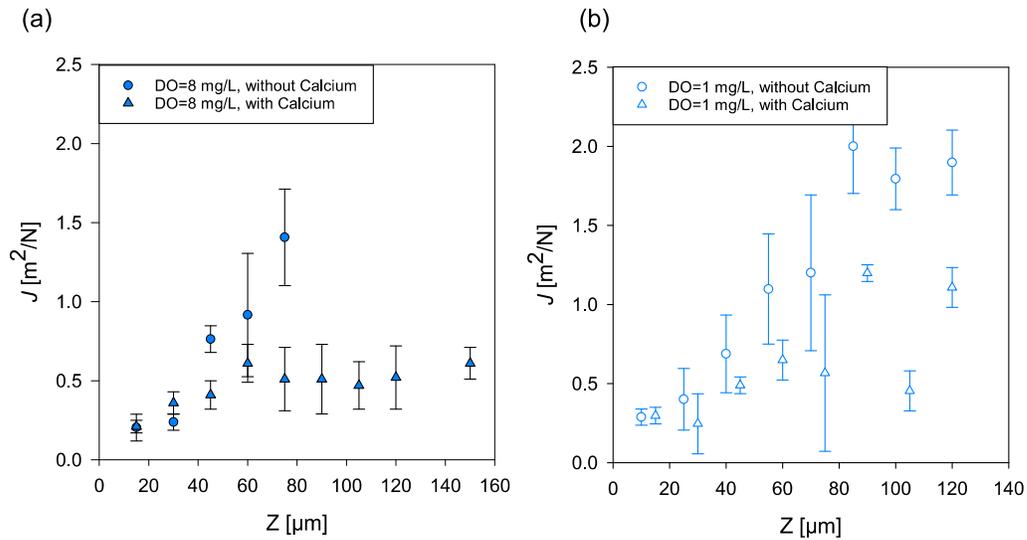


Figure 4. Vertical distribution of elastic compliance in biofilms grown at a medium flow rate of 0.1 mL/h ( $Re=0.28$ ) with and without  $Ca^{2+}$  after 5 days. (a) DO saturation ( $DO= 8$  mg/L); (b) low oxygen growth conditions ( $DO= 1$  mg/L)). The  $Ca^{2+}$  addition was 100 mg/L as  $CaCl_2$ . Error bars are the standard deviation for four replicates.

**Figure 5**

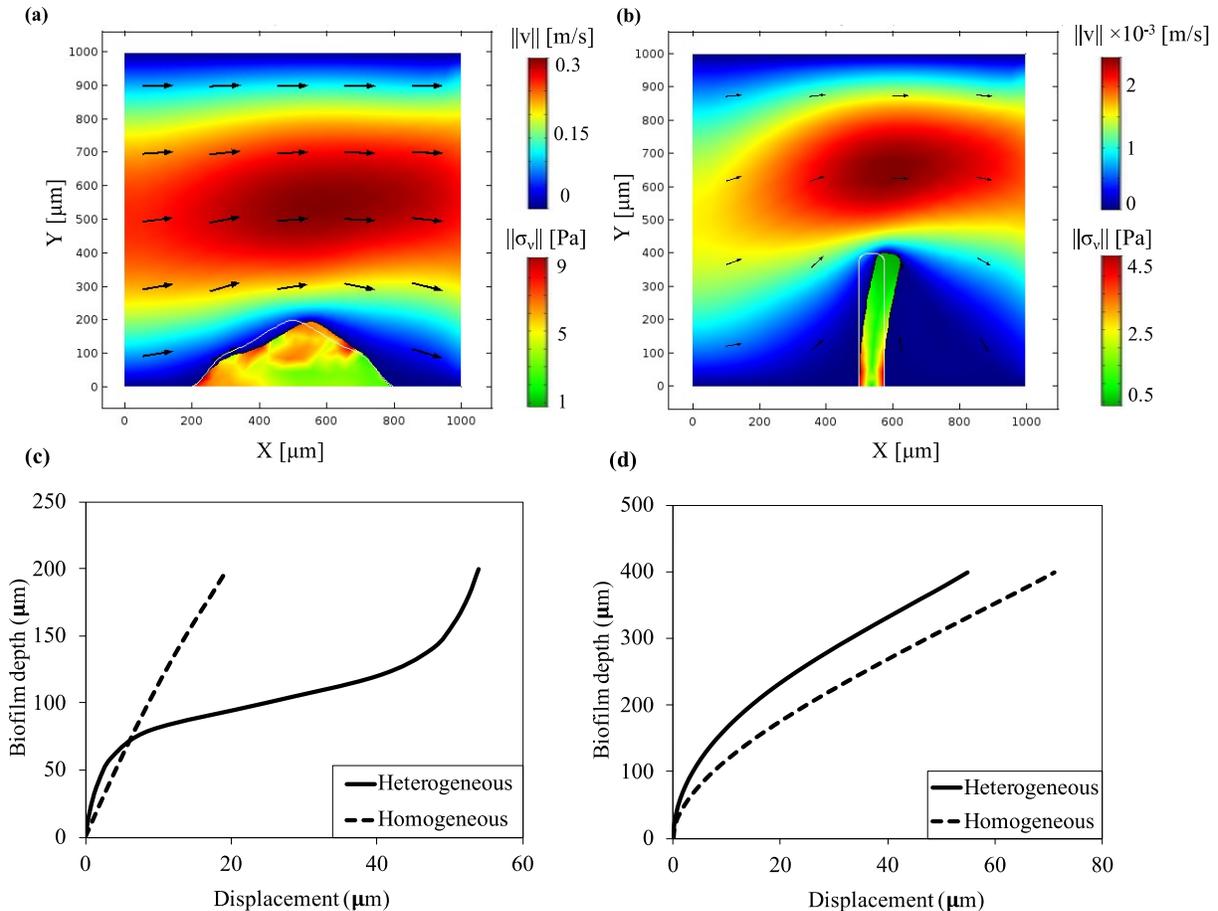


Figure 5. Modeling results for elastic deformation for biofilms with heterogeneous and homogeneous (averaged) mechanical properties. (a) Simulated velocity field ( $v$ : m/s) and the magnitude of von Mises stress ( $\|\sigma_v\|$ : Pa) in biofilm colony. (b) Simulated velocity field and the magnitude of von Mises stress in mushroom-like tower biofilm. White outlines indicate the original positions of biofilms at time zero. Surface in the solid domain is the magnitude of von Mises stress. Surface in fluid domain is velocity magnitude. Arrows indicate the velocity field. Simulated comparison of biofilm displacements assuming heterogeneous and homogeneous (averaged) mechanical properties for (c) biofilm colony and (d) biofilm tower. Displacements

are for the biofilm central-axis position for Re of 250 (a) and 1 (b) at time = 1.5 s. Biofilm depth of zero represents the biofilm-wall interface.