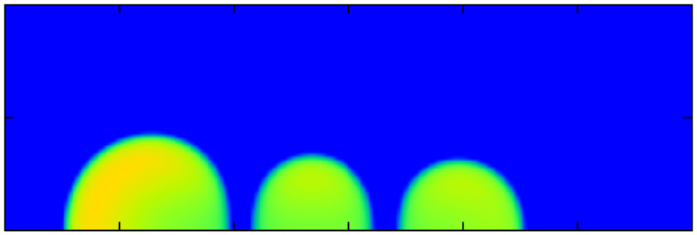
Research introduction

Numerical investigation of biofilm formation under fluid flow in a micro-channel

Keywords; Biofilm, Numerical investigation, flow field, flow channel geometry



Visualized biofilm obtained by numerical simulation

Okano laboratory

Introduction

Biofilm

Complex aggregation of microorganisms growing on a solid

Merit

Bio-remediation

Demerit

Medical infection

Food contamination

etc …

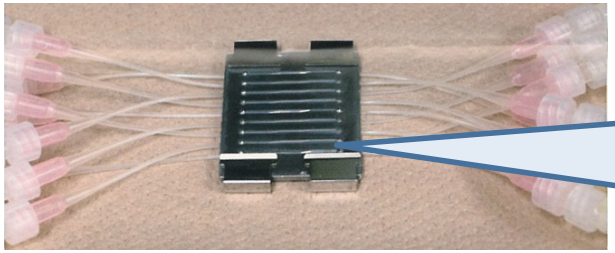
Control of biofilm formation

↓

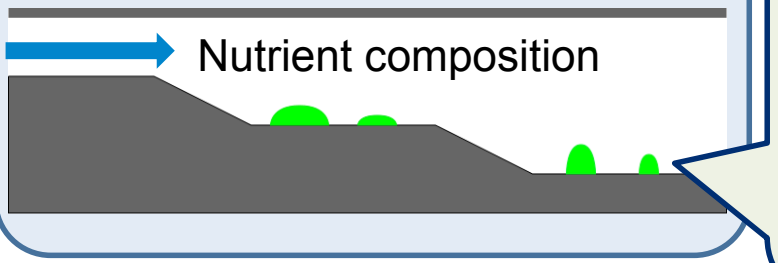
Understanding the mechanism of biofilm formation

Background

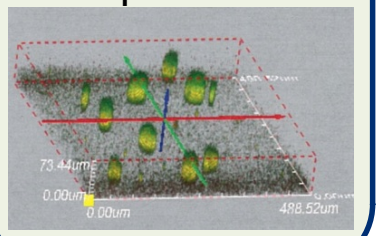
Micro-channel for experiments



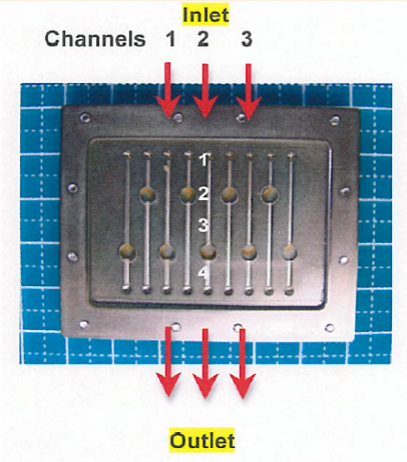
Cross-section view



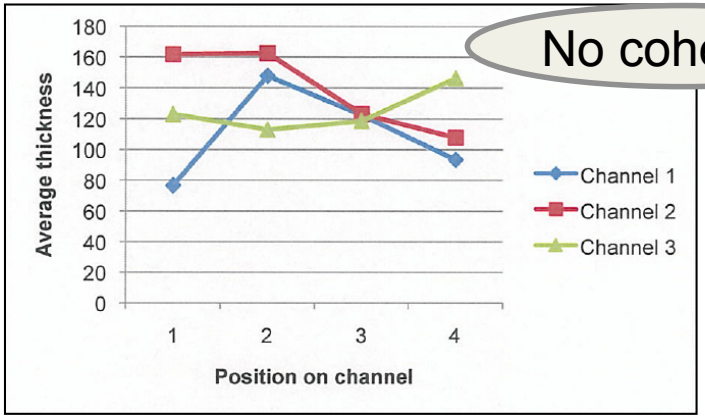
Biofilm observed in experiments



Experiments of biofilm growth



Results of experiments

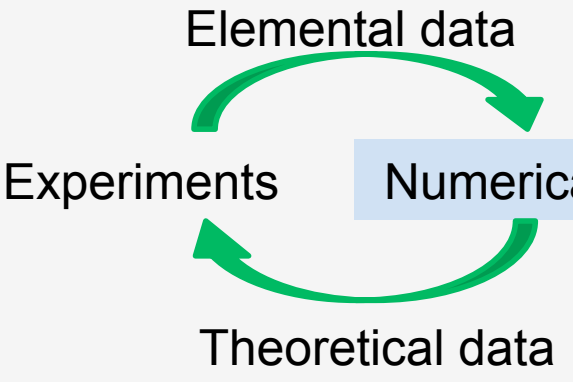


No coherence

Problem

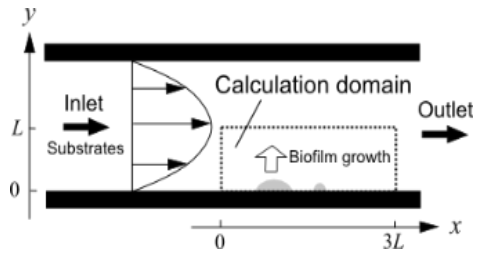
Difficulty of judging whether results were true or false

Objective of this research



Understanding the effect of flow field on biofilm formation

The effect of flow velocity

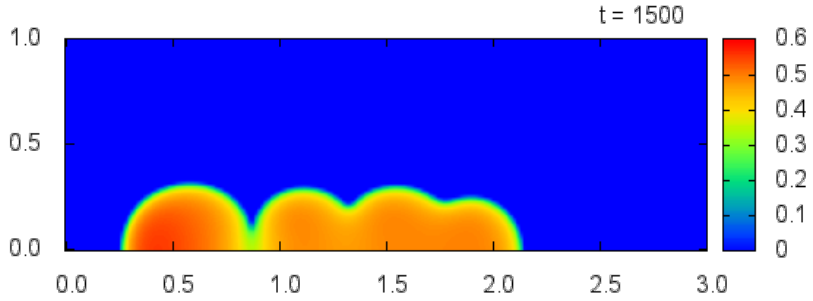


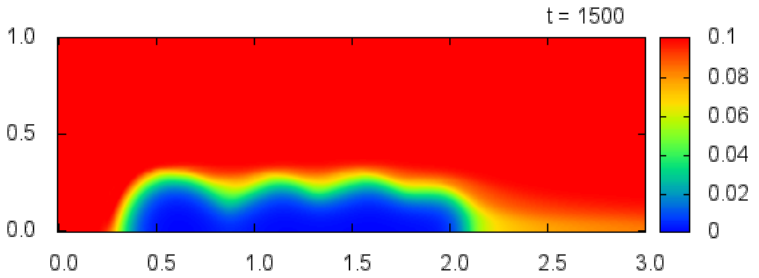
Two-dimensional numerical model
(flat plate)

Volume fraction of biofilm

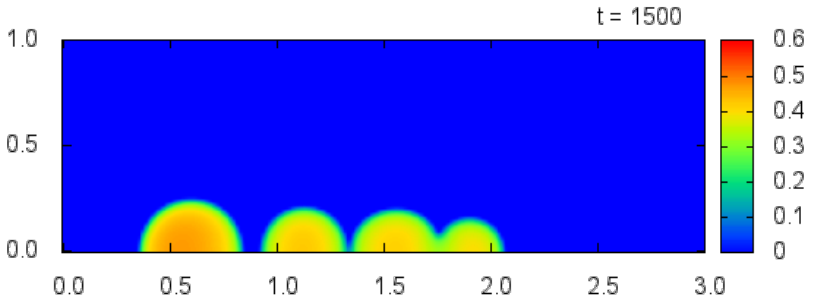
Concentration filed of nutrients

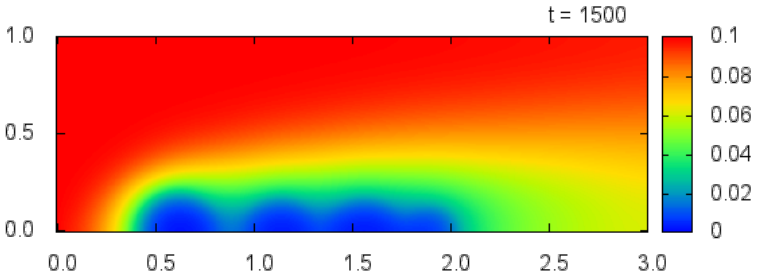
Re = 12.8





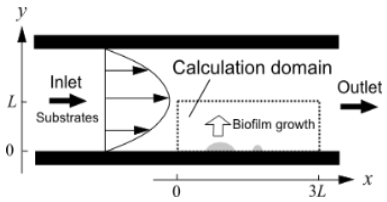
Re = 0.1



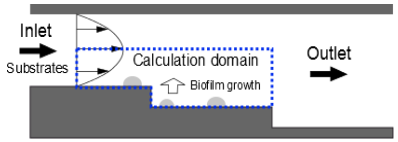


Higher Reynolds number flow velocity → More nutrients feeding to biofilm → Enhancement of biofilm growth

The effect of flow channel geometry

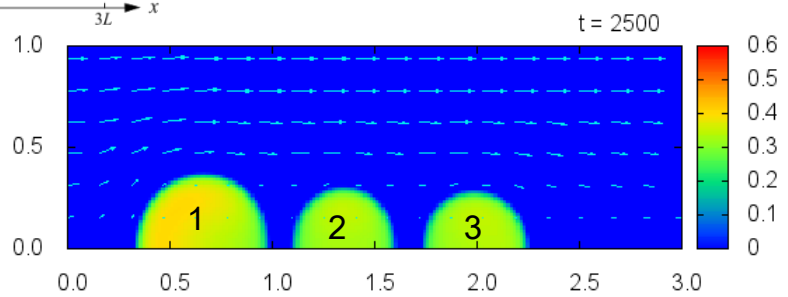


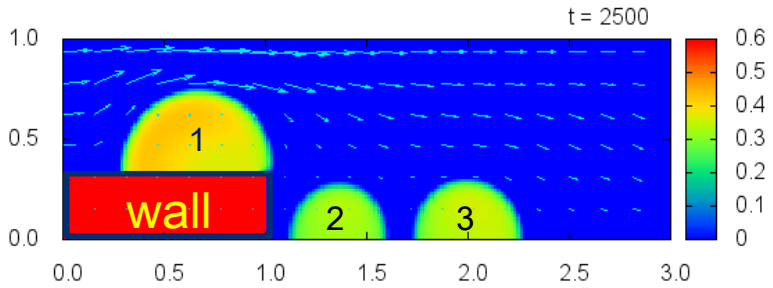
Flat plate



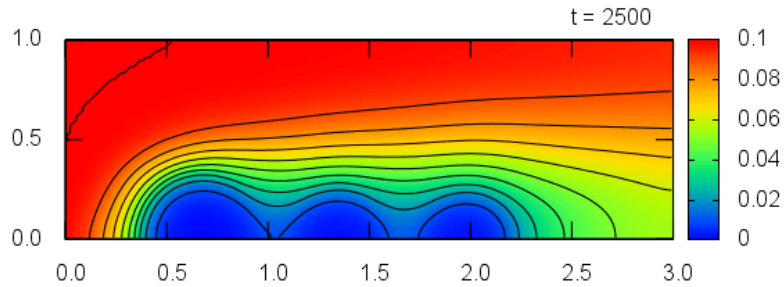
Back facing step

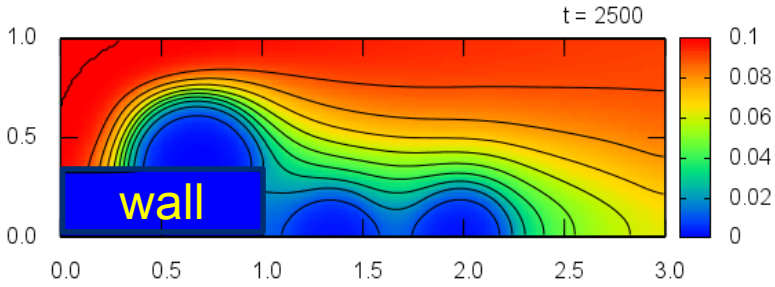
Biofilm and velocity vector



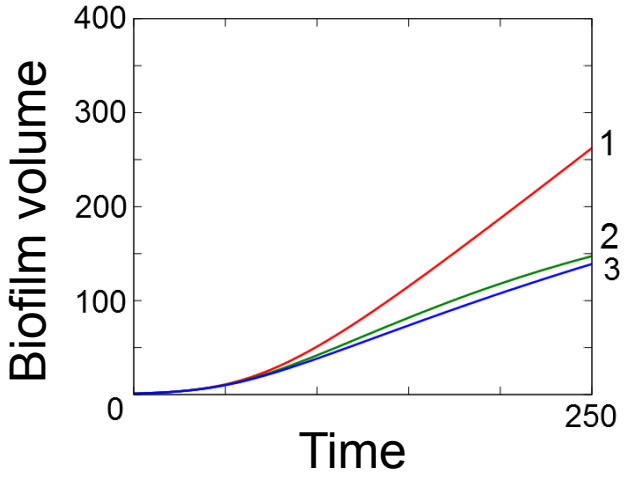


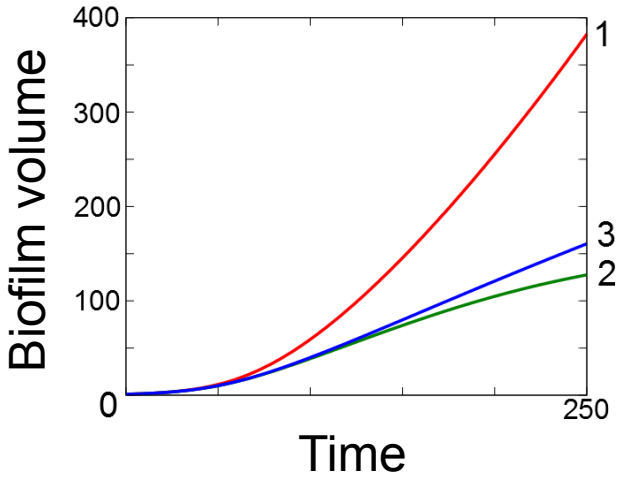
Concentration field of nutrients





Time evolution of biofilm volume





Summary

The behavior of biofilm formation varied depending on changes of flow field such as flow velocity and flow channel geometry.

Purpose

Better understanding the biofilm formation from the aspect of mass balance and mass transfer in flow field

Vision

The contribution to designing of the catheter with optimal geometry which biofilm can not easily form