

Preface

Since the early stage of the creation of life, bacteria have always been main actors on this globe, even though other organisms have evolved by adjusting to various environments throughout history. Sometimes bacteria have caused epidemics and the loss of life to many people. However on a daily basis, many of them have played important roles in producing foods and decomposing many materials (including those that are toxic) back to nature, etc. From that viewpoint, bacteria have been close companions to human beings, either good or bad. Actually, we did not know about their essence so much until recent times.

It was in the late 1970s that the notion of biofilm was first proposed. We found out gradually that bacteria in biofilm are the usual form, and that the planktonic bacteria just floating in air and aqueous systems, or growing in a certain culture are the rare ones. Also we have recently learned how different both types of bacteria are from each other.

Early on, research about bacteria was carried out in the medical field. Then the work expanded to the area of environmental science. Through research and development, a different notion called “quorum sensing,” the phenomenon of communication among bacteria was introduced into the mechanism of biofilm formation. Originally bacteriologists investigated quorum sensing quite separately, not relating it to biofilm. In the 1980s, another new revolutionary notion and technology came about. The former was molecular systems based on small subunit ribosomal RNA (SSU rRNA) genes. The latter was the quantitative community analysis for environmental microbes established by Dr. Norman Pace and his group. Not only biofilm, but also nature itself is composed of viable, but nonculturable (VBNC) bacteria, so it is very hard to solve the biofilm problems with a pure culture technique since Koch. The notion and technology in biofilm research were also introduced. The knowledge and information about biofilm have skyrocketed since then.

However, when we try to solve the daily industrial problems, the materials science and engineering fields seem to have the most important knowledge and information to tackle them, especially since biofilm generally forms at the interface between the microbe (environment) and materials. As described in many chapters of this book again and again, the biofilm formation starts by the attachment of bacteria to a surface. To solve the industrial problems, one should approach them from

both the environmental side and the materials side. However, there have been few investigations from the viewpoint of materials science and engineering. Our original aim was to complete the missing link between bacteriology and materials science. Since this is not the usual approach, our book was designed to be relatively fundamental so it is appropriate for beginners such as undergraduate students and nonbiological practical engineers. However, we believe this book also measures up to the expectations of graduate students, professional researchers, and high-level practical engineers. The authors worked hard as a team to prepare a book that meets the needs of a diverse audience.

Part I contains the fundamental parts. The life cycle of biofilm is composed of multisteps. Therefore, the process is divided into some steps and each is described in detail, respectively. In this part, readers will learn the basic knowledge about biofilm and prepare to move to the next part. Part II introduces many practical problems encountered in various industries on a daily basis. In this section the reader will get a chance to find the unexpected relationship between biofilm and industrial problems. Hopefully this part will be filled with many surprises. And Part III is composed of knowledge and information about solving problems of biofilm. In some chapters, you will learn how to remove and control biofilm. In other chapters, you will learn how to measure and evaluate biofilm properly and precisely. Even though some of these techniques are still under investigation, you will find out many evaluation methods available for materials scientists and engineers.

For many chapters of this book, the editors, Kanematsu and Barry, took the responsibility of writing them. However, many brilliant professionals were invited to join us and write their own chapters. You will get a chance to confirm their names and their parts in the Table of Contents. The editors removed the unnecessary and redundant expressions and descriptions in order to prepare a complete and integrated scholarly book. Each chapter is informative and written as a stand-alone, so the reader can begin anywhere in the book depending upon his/her interests and needs.

As we already stated, biofilm is still not fully understood and its meaning and importance for materials science and engineering are still underestimated. Therefore, we consider the readers of this book to be like sailors traveling to an unknown sea with *Biofilm and Materials Science* as a guide. We the editors and authors hope from the bottom of our hearts that this book will be a good guidebook and compass for your work and research (which may at times resemble traveling in an unknown sea). Bon voyage, all!

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Hideyuki Kanematsu and Dana M. Barry,
(book editors)
On behalf of the authors

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