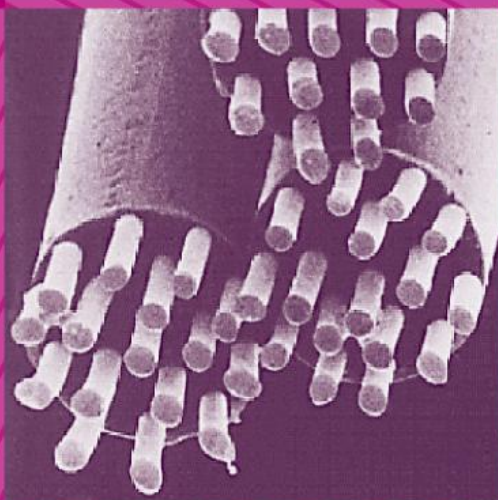


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New millennium fibers

Tatsuya Hongu, Glyn O. Phillips
and Machiko Takigami



The Textile Institute

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New millennium fibers

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Contents

| | | |
|-------------------------------|--|----|
| <i>Preface</i> | <i>ix</i> | |
| <i>Author contact details</i> | <i>xii</i> | |
| 1 | Searching the roots of fibers | 1 |
| 1.1 | The importance of fiber in human life | 1 |
| 1.2 | What is high-tech fiber? | 4 |
| 1.3 | Natural versus synthetic fiber | 10 |
| 1.4 | Artificial fiber by biomimetics | 12 |
| 1.5 | Definition of fibrous materials | 15 |
| 1.6 | Fiber: characteristics and shapes | 16 |
| 1.7 | Fibers as hierarchical structures | 18 |
| 1.8 | What should we investigate in the field of fiber and textiles? | 19 |
| 1.9 | Bibliography | 28 |
| 2 | The new frontier fibers? | 32 |
| 2.1 | Enlargement of the frontier in a fiber competition age | 32 |
| 2.2 | 'Selection', 'concentration' and 'originality' development on a world-wide scale | 35 |
| 2.3 | New fibers for the next generation have arrived | 43 |
| 2.4 | The distinction between high-tech fiber, frontier fiber, and new frontier fiber | 47 |
| 2.5 | Key words for the near future | 47 |
| 2.6 | How to develop new application fields | 49 |
| 2.7 | New frontier field now growing | 51 |
| 2.8 | Bibliography | 63 |
| 3 | Superfibers | 65 |
| 3.1 | Description of superfibers | 65 |
| 3.2 | Development of superfiber in Europe, the United States and Japan | 68 |

| | | |
|-----|---|-----|
| 3.3 | Superfiber as a reinforcing material | 69 |
| 3.4 | Frontiers of superfiber applications | 76 |
| 3.5 | Nanofiber (carbon nanotube) | 91 |
| 3.6 | High polyketone fiber | 92 |
| 3.7 | Bibliography | 95 |
| 4 | Carbon fiber expands towards the twenty-first century | 99 |
| 4.1 | PAN-based and pitch-based carbon fiber lead the world | 99 |
| 4.2 | A step of development of carbon fiber | 103 |
| 4.3 | The future of PAN-based carbon fiber | 127 |
| 4.4 | Bibliography | 128 |
| 5 | High function fiber | 130 |
| 5.1 | Prospects for high function fiber development | 130 |
| 5.2 | Sportswear using the high function fiber | 144 |
| 5.3 | Comfort function fiber | 151 |
| 5.4 | Biomimetic and intelligent fibers | 158 |
| 5.5 | The new areas | 166 |
| 5.6 | Bibliography | 168 |
| 6 | Frontier of health and comfort fibers | 173 |
| 6.1 | Fibers for health | 173 |
| 6.2 | Development of medical care materials to learn from 'smart fiber' | 179 |
| 6.3 | Development trend of comfortable fiber for health | 184 |
| 6.4 | Trend to seek for cleanliness and comfortableness | 186 |
| 6.5 | Fiber to guard environment and health | 204 |
| 6.6 | Technical concentration to achieve comfort | 212 |
| 6.7 | Bibliography | 216 |
| 7 | Polymer fibers for health and nutrition | 218 |
| 7.1 | The concept and effects of dietary fiber | 218 |
| 7.2 | Hydrocolloid fibers | 221 |
| 7.3 | The main hydrocolloids | 227 |
| 7.4 | Dietary fiber – in health and disease | 243 |
| 7.5 | The appropriate molecular features to achieve | 244 |
| 7.6 | Bibliography | 245 |
| 8 | Fibers in medical healthcare | 247 |
| 8.1 | Nonwoven | 247 |
| 8.2 | Alginate fibers | 248 |

| | | |
|-----|---|-----|
| 8.3 | Superabsorbent fibers | 250 |
| 8.4 | Wound healing and polysaccharide fibers | 251 |
| 8.5 | Hyaluronan – a new medical fiber | 255 |
| 8.6 | Other fibrous scaffolds for tissue engineering | 261 |
| 8.7 | Collagen: medical applications | 261 |
| 8.8 | Medical textiles | 263 |
| 8.9 | Bibliography | 268 |
| 9 | Developments in nanofibers for the new millennium | 269 |
| 9.1 | Background | 269 |
| 9.2 | Nanotechnology, materials and nanofiber | 271 |
| 9.3 | Creation of new industries | 283 |
| 9.4 | Researches and global developments of nanofiber | 286 |
| 9.5 | Further reading | 287 |
| 9.6 | References | 287 |

Looking forward into the twenty-first century, it is becoming clear that the narrow concept of a fiber as something capable of being used for clothing and related areas is becoming outmoded. Fibers in biological systems are driving the new fiber science and technology, which is flourishing in Asia and particularly in China. No longer can there be reliance on products based on petroleum, which is already proving unreliable in maintaining guaranteed supplies. Alternatives must be found, preferably from renewable sources. Energy saving, securing the environment along with personal health and safety will call for a greater emphasis on quality rather than quantity. It is the climate in which the nanofibers have appeared. Japan has been a pioneer in combining fiber design with biological function (biomimetics) and has pioneered this bottom-up type of development, but now more top-down type investigations are also called for and are slowly gaining momentum. One practical result of this approach has been the market launch of 'Morphotex[®]' with the layered structure of nanofiber as in the MORPHO butterfly.

It is these newer areas, which are likely to appear during the twenty-first century, which are given emphasis in this book. It follows and is meant to supplement our previous two books, both entitled *New Fibers*. The first edition was published in 1990, then by Ellis Horwood Ltd. It was extremely well received and we were encouraged by Woodhead Publishing Limited (who acquired the assets of Ellis Horwood) to produce a revised edition in 1997. We have named this new volume *New Millennium Fibers* to preserve the same approach and to follow on from our other two volumes. We hope that it will be received just as enthusiastically. Once again the emphasis is on developments in fiber technology and applications, mainly in Japan. It opens up to Western countries the type of thinking which directs the fiber science and technology industry in Japan, and thus to a global perspective.

The Japanese fiber textile industry is characteristically technology-oriented. Its innovative approach led to Shingosen ultra-fine fiber, and the new target is now high-tech fibers. These are the fibrous materials produced by advanced technology, and include high performance fiber with ultra-strength, high

function fiber with various functions for health care, comfort etc., and high touch fiber with superb hand feel.

Fiber textiles science and technology is moving forward positively into the twenty-first century, and the prospect is that the new fiber textile materials will be developed in association with other industrial fields. Fiber textile technology, for example, has closely followed and been greatly influenced by the information technology (IT) and biotechnology revolutions. Tension members for supporting optical fibers, integrated circuit boards for mobile phones, and wearable computers are examples where fiber textile technology has interfaced with the IT revolution. Bacteria are known to produce cellulose and polyester, and soon there could be more industrial bio-plants to produce fibers. Many chemical fibers and textiles in the twentieth century were developed by mimicking the structure of natural fibers, using the approach called 'biomimetics'. These fibers and textiles could well themselves possess bio-functions in the twenty-first century. This book projects the subject into this exciting future. [Chapter 1](#) describes fibers and textiles in general, and identifies the scope of high-tech fibers. [Chapter 2](#) reviews the present status and prospects of fiber textile technology, into what we have termed 'new frontier fiber'. [Chapter 3](#) reviews the high performance fiber from its origin to its future application. Carbon fiber is used as an example of a typical high performance fiber in [Chapter 4](#).

Thereafter, attention is focused on health care and the environment. We wish to convince the reader that fiber textile technology can be pivotal in helping to enrich our lives in the twenty-first century. Fibers in the twentieth century were perceived mainly in terms of clothing, ropes or nets by the consuming public. These were the visible areas which people could recognize. In the twenty-first century fibers will enter into novel and unexpected applications. We are approaching the age of the wearable computer and organic electroluminescent wearable displays. New potential is open to fibers by building on traditional fiber engineering which produced fiber composite materials for the amusement and car industries, civil engineering and construction, and the aerospace industry; separation membranes using hollow fibers for artificial organs, plastic optical fibers for information technology, biodegradable fiber for ecological conservation; and fibers with biological functions. A greater integration will ensure their increasing contribution to new aspects of the environment and human life.

The book moves away from a narrow interpretation of fiber. Surely the scope of fibers will be enlarged in the twenty-first century away from the visible fiber cloths of the twentieth century to unseen fiber composite materials, and from fibers for practical conventional use to molecular fiber, and nanofiber which can themselves control operations. It is an exciting future. The ideas have already been advanced in the Japanese language in the books by Dr Hongu: *High-Tech Fibers* (1999) and *New Frontier Fibers* (2000). We have

received great support in initially transporting these ideas into English by Professor Dr Kanji Kajiwara, Otsuma Women's University, and valuable information about recent trends in fiber technology were conveyed by Professor Dr Akihiko Tanioka and Dr Masatoshi Tokita, Assistant Professor of Tokyo Institute of Technology. We thank them and also Nikkan Kogyo Sinbun-sha for permission to use information from the books mentioned, and member companies of the publicity committee of the Japan Chemical Fiber Association and other fiber-related companies for valuable photographs and data.

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