Preface from authors

The development of space technology has promoted the progress of satellite thermal control technology. Thermal control thin films, which has the advantages of light weight, superior stability, and thermal-property designable, is becoming one of the important trends of spacecraft thermal control technology. After decades of development, thermal control film products have gradually developed from less variety to several categories, and their structure, principle, function, preparation technology, and application range also show a diversification.

After many years of technology research and development and engineering practice, the authors and peers, experts and technicians generally feel that there are no books systematic and specialized on thermal control film technology although spacecraft thermal control film technology has developed rapidly. Therefore, it is necessary to have a comprehensive and systematic review of the thermal control film technology.

The book consists of seven chapters. Chapter 1 summarizes the basic theory, technical basis, space thermal environment and radiation environment, classification of thermal control films, application of thermal control films and development status, and trend of thermal control film technology. Chapters 2 and 3 introduce two types of single and multilayers composite thermal control films, a total of ten widely used thermal control films. In these two chapters, we discuss the basic concepts, thermal control principles, functions, and characteristics of these ten conventional thermal control films. The technical level and development status are discussed with more detailed data, and the future development trend of these passive thermal control films is analyzed. Chapters 4 and 5 introduce the new type thermal control thin-film technology developed in recent ten years, which covers several intelligent thermal control thin films and microstructure thermal control thin-film technology based on MEMS system. The design, theoretical calculation, preparation methods, properties, and characteristics of thin films are discussed systematically. Chapter 6 mainly introduces several common thin-film preparation technologies for thermal control thin films, including vacuum evaporation, magnetron sputtering, microwave CVD, sol-gel and atomic layer deposition, and the characteristic analysis methods of the structure; composition; and electrical, optical, and thermal properties of thin films have been described. Chapter 7 introduces the test and evaluation techniques of thermal control films, namely the relevant environmental and irradiation test methods.

This book comprehensively summarizes the development experience and research results of spacecraft thermal control thin films, the emphasis is on the design theory, new technology, and new methods of the few decades. The design method, preparation technology, and related test are described in detail as more as possible. The contents cover conventional thermal control thin films, new developed thermal control thin films, and intelligent thermal control films.

The authors of this book have been engaged in the research and development of spacecraft thermal control film for a long time, and therefore they are familiar with the international technical status and development trend of related technologies. Thermal control thin films developed by the authors and their team have been successfully applied on various spacecraft in China and some foreign commercial satellites. All the flight products have been shown with good performances, and the technology level of some products have reached the international advanced level. A series of new thermal control thin films are being developed, which will play an important supporting role in future application. The main contents of this book are the authors' summary of practice accumulated over many years. The main data also come from scientific research and production experiments. Many of the data are the latest research results. It is hoped that this book can be shared with peer, and that it can provide some reference for spacecraft thermal control designers, engineers, and developers.

The authors would gratefully thank Xu Min, Wang Jiebing, Wang Yi, Cao Shengzhu, Xiong Yuqing, He Yanchun, Wang Zhimin, Wang Duoshu, Wang Lanxi, Yang Miao, Wang Jinxiao, Wei Bo, Wang Hu, Wu Gan, and Zhang Ling at National Key Laboratory on Vacuum Technology and Physics for their selfless help during the process of writing this book.

While applying for publishing fund for the first edition, we have been encouraged, recommended, and supported by Prof. Min Guirong; academicians of Chinese Academy of Science (CAS) and Chinese Academy of Engineering (CAE); and Prof. Yu Dengyun, Deputy Director of Science and Technology Committee of China Aerospace Science and Technology Group Corporation (CASC). In particular, Prof. Min has written the preface to this book regardless of his illness. The authors hereby express our great respect and heartfelt thanks.

Jia-wen Qiu