PROCEEDINGS OF THE FIRST CHINESE SYMPOSIUM ON MICROGRAVITY SCIENCE AND SPACE EXPERIMENTS

NOV. 11–14, 1987

BEIJING, CHINA.

中国科学技术出版社

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中国微重力科学与空间实验

——首届学术讨论会论文集

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主编的话

在我国跟踪世界高技术发展的重大决策指引下，在不到一年的时间里，在航天部、国家科委和中国科学院的支持下，全国各有关单位大力协同，利用我国回收卫星完成了一批微重力科学和其它空间应用科学的实验。与此同时，利用在地面可以获得的其它微重力条件开展的微重力科学研究也取得了初步成果。这次会议的大部分论文反映了这些成果，主要集中在材料科学和生命科学两个领域。这次学术会议的召开标志着我国已经进入开辟微重力和空间应用科学的新阶段；表明我国有能力独立自主发展空间科学。

根据各单位分散的力量，一年前的今天我们还没有预料到目前取得的这些成果。开辟这一新局面的重要经验就是全国大力协同。工业部门为科研部门提供条件，科研部门提供地面科学研究的成果以及科技支持，缺一不可，谁也离不开谁。这种精神今后还要继续发扬。我们是一个发展中的大国，一穷，二落后，只有依靠艰苦奋斗和社会主义大协作才能够跟踪世界高技术的发展。还应该清醒地认识到，我们在微重力科学和其它空间应用科学中只是取得了初步成果，正处于开辟新领域和积累经验的阶段。研究领域还须扩大，水平还要不断提高。全世界的微重力科学和空间应用科学还处于发展时期，新的技术将不断涌现，我们必须努力学习。

林兰英

1988 年 3 月

PREFACE

Under the guidance of important policy-makings with respect to tracing worldwide high technology developement, a series of micro-gravity science and other space application experiments have been carried out by related institutions in good cooperation in this country using state-owned recovered satellites during a period of time less than one year under the sponsorship of Ministry of Astronautics, State Science and Technology Commission and Chinese Academy of Sciences. Meanwhile elementary achievements have been gained by efforts of micro-gravity conditions available on the ground. The most papers presented in this conference are reflecting these achievements, mainly concentrating on the two fields, materials science and life science. The opening of this symposium means that China has paced into a new stage being engaged in micro-gravity science and space application science, indicating that China has the capability to develop space science independently by her own efforts.

As the overall strength of theafforestated institutions was not coalesced, this day one year ago, we had not foreseen such achievements as currently obtained. One important experience to create such a new situation is actually better and even better cooperation all over the country. The industries prepare conditions and services for space scientific research institutions while the latter offer research achievements on the ground as well as scientific and technological support to the former. Both are necessary and one cannot be short of the other. Such cooperation and spirit should be further strengthened

in the future.

China is a developping country, poor on the one hand, and backward on the other, only can she trace the worldwide high technology developmemnt, depending on hardworking struggle and socialist great cooperation. It should also be clearly understood with a cold head that we have won but elementary achievements in micro-gravity science and other space experiments and we are still in a stage to create new frontiers and accumulate new experiences. The research fields should be enlarged furthermore and the research level should be continuously elevated. The micro-gravity research and space application science worldwide are still in a developping phase and new technologies will consistently arise, we must study hard and learn from others.

Lin Lanying

March, 1988

前　言

航天科学技术是20世纪最引人注目的重大科学技术成就之一。它的一个引人入胜之处，就在于提供了一个可在微重力条件下，从事科学探索和开发应用技术的环境，使人们可以进行在地球上无法开展的科学实验和技术革新，其前景非常光明。这就是各个工业先进国家对在微重力条件下的科学技术热情关注、踊跃投资、积极组织和推动的重要原因。

引人自豪的是，我国在航天技术发展方面已取得了举世瞩目的成就。这就为开展在微重力下的科学实验创造了优良的条件。在国家科委、航天工业部和中国科学院等有关部门的共同组织和推动下，1987年8月，我国科学家首次利用自己的可回收卫星成功地进行了生命科学和材料科学方面的实验。这次实验的结果是令人鼓舞的，获取了许多重要的结果，验证了不少有特色的科学思想，尤其应当指出的是在微重力下GaAs单晶的生长等是很有特色的。理所当然引起国内外广泛的兴趣。

为检阅这次试验的成果，交流学术心得体会，我们于1987年11月在北京召开了我国首届微重力科学技术讨论会。作为会议的收获，我们将会议上宣读的论文报告编印成这本文集出版。

众所周知的是，空间科学实验投资很大而且技术要求很高，因此国际交流和合作是非常重要的。我国在空间领域正与一些友好国家探讨合作。为使国际上对我们的工作有所了解，每篇论文附有英文摘要并选择其中一部分以英文本单独发行。

这次论文集的出版，郑立中、钟兴儒、潘厚任、王景涛、杜雅如等同志付出了辛勤的劳动。这里记名示绩。

马俊如

1988年3月

Foreword

The recent advancement of astronautic science and technology is one of major achievements among the great successes of science and technology in the 20th century. The outerspace providing an environment of microgravity conditions has very strong attraction to scientists. Special scientific experiments and technical innovations can be carried out under such conditions which are impossible on the earth, committing a bright future for space science and application, I suppose this is the key reason why a lot of advanced countries are interested in space science and technology under microgravity and making positive efforts in the organization of these studies.

We are proud of the great achivements of the development of space technology in our country. It creats very good basic condition for experiments under microgravity, The first experiments of the life science and materials science have been carried out by Chinese scientists from related institutions in good cooperation, using state–owned retrievable satellites in August. 1987, under the sponsorship and organization of State Science and Technology Commission(SSTC), Ministry of Astronautics and Chinese Academy of Sciences(CAS). The excellent experiments have been very inspiring. Some important results have been gained and the scientific ideas with distinctive feature have been proved. It is worth to point out, that the single crystal growth of GaAs under microgravity is attracting broad interests both from home and abroad.

In order to review the achievement of the experimental results and to exchange information about what we have gained, the lst Chinese Seminar of Sci-

ence and Technology under Microgravity of China was held in Beijing in Nov. 1987. As a record of the conference, the announced papers are collected in this volume for publication.

It is well known that to develop the space science and technology needs big investment and good technological support. In this case, international cooperation is very important, especially for a developing country. The worldwide cooperation in this area has been explored between China and some friendly countries. For the sake of good understanding of our activities under microgravity, beside this procceding in which the English abstracts are included, some abstracts are again to be selected for publishing in a separate English issue.

For the sake of publishing this collected work, Mrs. Zheng Lizhong, head of Division of Outer Space and Remote Sensing, SSTC, Prof. Zhong Xingru from Institute of Semiconductor, CAS, Prof. Pan Houren, from Division of Technological Sciences, CAS, Prof. Wang Jingtao and Mrs. Du Yaru from the Research Center of Space Science and Application, CAS, etc. for their Contributions forwards this publication.

Ma Junru

Director, Bureau of New Technologies, SSTC

March, 1988

目　　录

材 料 科 学

空 间 技 术

MATERIAL SCIENCE

SPACE TECHNOLOGY