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**2024年6月**

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|  |  |  |
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| 授予学位单位 | ： | 华北电力大学 |

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↑

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↑

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| **Supervisor：** | Prof.□□□ |
| **Co- Supervisor：** | Prof.□□□ |
| **Academic Degree Applied for：** | Doctor of □□□□ |
| **Subject:** |  |
| **Speciality：** |  |
| **School：** | School of  |
| **Date of Defence：** | June, 2024 |
| **Degree-Conferring-Institution：** | North China Electric Power University |

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# 摘 要

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摘要是论文内容的高度概括，应具有独立性和自含性，即不阅读论文的全文，就能获得必要的信息。摘要应包括本论文的目的、主要研究内容、研究方法、创造性成果及其理论与实际意义。摘要中不宜使用公式、化学结构式、图表和非公知公用的符号和术语，不标注引用文献编号。避免将摘要写成目录式的内容介绍。

关键词：关键词1；关键词2；关键词3；……；关键词5

**（Content and keywords in 12pt, SimSun）**

Except for the cover and inner cover, each page of the thesis should have a header, with a bold and thin double line (with a bold line on top and a width of 0.8mm) separated by a line on the core. The header should be printed in the center on the double line. The font size is 9pt, SimSun. The odd numbered pages header of the doctoral thesis is the title number and title of this chapter, while the even numbered pages header is "Doctoral Dissertation of North China Electric Power University".

# **Abstract**

(Times New Roman 18pt, bold)

Externally pressurized gas bearing has been widely used in the field of aviation, semiconductor, weave, and measurement apparatus because of its advantage of high accuracy, little friction, low heat distortion, long life-span, and no pollution. In this thesis, based on the domestic and overseas researching……

**Keywords**: keyword 1，keyword 2，keyword 3， ……，keyword 5

**(The content of the English abstract and the Chinese abstract should be consistent and accurate in grammar and vocabulary. Use commas to connect keywords. Content and keywords in 12pt, Times New Roman)**

# 目 录

(SumHei 18pt)

摘要..............................................................................................................І

**Abstract**......................................................................................................ІІ

第1章 绪论.................................................................................................1

1.1 课题背景及研究的目的和意义.......................................................1

1.2 气体润滑轴承及其相关理论的发展概况........................................2

1.2.1气体润滑轴承的发展.............................................................2

1.2.2气体润滑轴承的分类..............................................................4

……

1.3 计算流体动力学及其在相关领域中的应用....................................13

……

1.5 本课题的主要研究内容..............................................................16

第2章 静压轴承多孔质石墨渗透率的研究..............................................18

2.1 引言….........................................................................................18

2.2分形几何理论.................................................................................18

……

2.4 本章小结.......................................................................................24

……

第7章 结论与展望...............................................................................................86

参考文献...................................................................................................88

攻读博士学位期间发表的论文及其它成果.........................................................96

攻读博士学位期间参加的科研工作............................................................97

致谢............................................................................................................98

作者简介....................................................................................................99

**(Chapter headings in bold, section, article and paragraph headings in SimSun, all in 12pt)**

# **Contents**

（Times New Roman 18pt, bold）

**Abstract (In Chinese)**........................................................................................І

**Abstract (In English)**........................................................................................ІІ

**Chapter 1 Introduction**......................................................................................1

1.1 Background, objective and significance of the subject................................1

1.2 Developmental of gas-lubricated bearing and correlated theories...............2

1.2.1 Developmental of gas-lubricated bearing.................................................2

1.2.2 Research on static characteristics of porous externally Pressurized

gas bearing........................................................................................10

 ……

1.3 Computational fluid dynamics and applications of correlated field...........13

……

1.5 Main research contents of this subject......................................................16

**Chapter 2 Research on permeability of** ..........................................................18

2.1 Introduction..............................................................................................18

2.2 Fractal geometry theory............................................................................18

……

2.4 Brief summary..........................................................................................24

……

**Chapter 7 Conclusions and prospects....**.............................................................86

**References**.........................................................................................................88

**Papers published in the period of Ph.D. education**.........................................96

**Research Work in the period of Ph.D. education**.........................................97

**Acknowledgements**...........................................................................................98

**Author’s Brief Introduction**.....................................................................99

**（Times New Roman 12pt, chapter names must be in bold）**

**Chapter 1 Introduction**

(Times New Roman, 18pt, Bold, placed in the middle; Paragraph Line Spacing: 1.35 line)

(Times New Roman, 16pt, Bold; Paragraph Line Spacing: 1.35 line, 0.5 line spacing before and after)

**1.1 Research Background**

The development of advanced technologies such as national defense industry and microelectronics industry requires precision and ultra-precision instruments and equipment, and high-speed precision instruments and equipment. …… **(Times New Roman, 12pt; Paragraph Line Spacing: 1.25 line, Indent the first line by 2 characters)**

……

**1.2 Development of Gas Lubricated Bearings**

Gas bearing is a mechanical component which supports load or reduces friction by gas film. ……

……

**1.2.1 Development of Gas Lubricated Bearings** (Times New Roman, 14pt, Bold, 0.5 line spacing before and after)

In 1828, R.R.Willis[3] published an article on pressure distribution in orifice throttle plates, which is the earliest recorded literature on gas lubrication. ……

.......

**1.2.5 Study on Porous Gas Hydrostatic Bearing**

Because of the low pressure and compressibility of gases …… .

[**1.2.5.1**](1.2.5.1) **Classification of Hydrostatic Bearing** (Times New Roman, 12pt, Bold; 0.5 line spacing before and after)

The Porous Hydrostatic Bearings can be classified as … … ..

[**1.2.5.2**](1.2.5.2) **Study on the Properties of Porous Materials**

The main characteristic of the material is that it has a certain degree of....

1. Porous materials with porous properties are made up of....

.........

**Chapter 4 Research on Bearing Static**

**Characteristics Based on FLUENT Software**

**4.1 Introduction**

Using existing commercial software to study flow field can avoid solving N-S equation program. ……

**4.2.3 The Setting of Boundary Conditions**

In this paper, we adopt... In each direction... From the following two formulas:

(4-1)

(4-2)

In formula *Dp* ——Average particle diameter of porous materials (m)；

——Porosity (Pore volume as a percentage of total volume)；

——Characteristic permeability or intrinsic permeability, related to the structural properties of materials (m2).

……

**4.3.3 Analysis of FLUENT simulation results**

Figure 4-6 shows the pressure distribution in the local porous cylinder plunger and in the gas film when the radius of the local porous cylinder is different. The radii are *rr*=1.5mm, 2.5mm, 3.5mm and 4.5mm, respectively. From Fig.4-6, it can be seen that the throttling effect is very different because of the different throttling radius. Among them, the throttling effect with small radius is obvious. The pressure change corresponding to Fig.4-6 a) is the most obvious, while the change of Fig.4-6 d) is very small, which results in a great difference in the pressure distribution in the gas film. Thus, the bearing capacity is greatly improved with the increase of radius.



a)

b)



c)

d)

Fig.4-6 Pressure contour of bearing with partial porous plunger different radiuses

a) Pressure contour of bearing when R=1.5mm, b) Pressure contour of bearing when R=2.5mm
c) Pressure contour of bearing when R=3.5mm, d) Pressure contour of bearing when R=4.5mm

（It can also be written as shown in the example below）



a) Pressure contour of bearing when

**=1.5mm

b) Pressure contour of bearing when

**=2.5mm



d) Pressure contour of bearing when

 **=4.5mm

c) Pressure contour of bearing when

**=3.5mm

Fig.4-6 Pressure contour of bearing with partial porous plunger different radiuses

## **4.4 Conclusion**

……

**Chapter 6 Experimental study on partial porous hydrostatic bearings**

**6.1 Introduction**

In the preceding chapters, the permeability of locally porous materials is studied, respectively ……

**6.2 Porous graphite permeability test**

……

The experimental data of sample No.1 is shown in the table. 6-1.

Table 6-1 Data of measured permeability of sample 1

(Temperature: *T*=16℃ Height: *H*=5.31mm)

**Times New Roman, 10.5pt; the table need to be the standard three-lines table, title need to set on the top of table. Before the title, tag need to be set, example: “Table 6-1”**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Gas supply pressure*Ps* (MPa) | Flow measurement *M* ′(m3/h) | Flow correction value *M* (m3/s) × 10-4 | Pressure difference *ΔP* (Pa) | Lg *ΔP* | lg*M* |
| 0.15 | 0.009 | 0.02312 | 46900 | 4.67117 | -5.63601 |
| 0.2 | 0.021 | 0.04584 | 96900 | 4.98632 | -5.33876 |
| 0.25 | 0.039 | 0.07413 | 146900 | 5.16702 | -5.13001 |
| 0.3 | 0.097 | 0.16747 | 196900 | 5.29424 | -4.77606 |
| 0.35 | 0.136 | 0.21753 | 246900 | 5.39252 | -4.66248 |
| 0.4 | 0.171 | 0.25485 | 296900 | 5.47261 | -4.59372 |
| 0.45 | 0.202 | 0.28467 | 346900 | 5.54020 | -- |

……

.....If the form is more than one page long, it can be moved to the next page in the form of a continuation sheet:

Table 6-1 Data of measured permeability of sample 1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Gas supply pressure*Ps*(MPa) | Flow measurement *M* ′(m3/h) | Flow correction value *M* (m3/s) × 10-4 | Pressure difference Δ*P* (Pa) | lgΔ*P* | lg*M* |
| 0.15 | 0.009 | 0.023 12 | 46 900 | 4.671 17 | -5.636 01 |
| 0.2 | 0.021 | 0.045 84 | 96 900 | 4.986 32 | -5.338 76 |
| 0.25 | 0.039 | 0.074 13 | 146 900 | 5.167 02 | -5.130 01 |
| 0.150.20.250.150.20.250.150.20.250.150.20.250.150.20.250.3 | 0.0090.0210.0390.0090.0210.0390.0090.0210.0390.0090.0210.0390.0090.0210.0390.097 | 0.023 120.045 840.074 130.023 120.045 840.074 130.023 120.045 840.074 130.023 120.045 840.074 130.023 120.045 840.074 130.167 47 | 46 90096 900146 90046 90096 900146 90046 90096 900146 90046 90096 900146 90046 90096 900146 900196 900 | 4.671 174.986 325.167 024.671 174.986 325.167 024.671 174.986 325.167 024.671 174.986 325.167 024.671 174.986 325.167 025.294 24 | -5.636 01-5.338 76-5.130 01-5.636 01-5.338 76-5.130 01-5.636 01-5.338 76-5.130 01-5.636 01-5.338 76-5.130 01-5.636 01-5.338 76-5.130 01-4.776 06 |

Table 6-1 (continuation table)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Gas supply pressure*Ps*(MPa) | Flow measurement *M* ′(m3/h) | Flow correction value *M* (m3/s) × 10-4 | Pressure difference Δ*P* (Pa) | lgΔ*P* | lg*M* |
| 0.35 | 0.136 | 0.217 53 | 246 900 | 5.392 52 | -4.662 48 |
| 0.4 | 0.171 | 0.254 85 | 296 900 | 5.472 61 | -4.593 72 |
| 0.45 | 0.202 | 0.284 67 | 346 900 | 5.540 20 | — |

**6.5 Conclusion**

…

**Chapter 7 Conclusion and Prospect**

The conclusion of the dissertation is arranged separately as the last chapter of the main body of the paper.

The conclusion is a summary of the main results of the whole paper. In the conclusion, we should clearly point out the creative achievements or innovative point theory (including new insights and new points of view) of the content of this research should be clearly pointed out, as well as the outlook and conception of further research work in the direction of this research in the future, and the conclusion should not be written as an abstract of the paper. The content of the conclusion is generally less than 2000.

**References**

1. 毛峡．绘画的音乐表现[A]．中国人工智能学会2001年全国学术年会论文集[C]．北京：北京邮电大学出版社,2001:739-740
2. 张和生．地质力学系统理论[D]．太原：太原理工大学,1998
3. Quagliano L G, Nather H. Up conversion of luminescence via deep centers in high purity GaAs and GaAlAs epitaxial layers[J]. Applied Physics Letters, 1984, 45(5):555
4. Quagliano L G, Nather H. Up conversion of luminescence via deep centers in high purity GaAs and GaAlAs epitaxial layers[J]. Applied Physics Letters, 1984, 45(5):555

……

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**Papers published in the period of Ph.D. education**

**1. Published academic papers**

1. ×××，×××. 部多孔质气体静压轴向轴承静态特性的数值求解[J]．摩擦学学报，2007 ，38(12) :68~72(EI 收录号： 071510544816)

**2. Patents applied for and obtained (this need not be listed in the absence of patents)**

1. ×××，×××. 一种温热外敷药制备方案：中国，88105607.3[P]. 1989-07-26.

**3. Science and technology awards (not listed when no award is awarded)**

1. ×××，×××. ××静载下预应力混凝土房屋结构设计统一理论. 黑龙江省科学技术二等奖, 2007.

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**Research Work in the period of Ph.D. education**

[1]

[2]

**Acknowledgement**

I sincerely thank my mentor, Professor XXX, for his meticulous guidance. His words and deeds will benefit me all my life.

Thank you, Professor XXX, and all the teachers and students in the laboratory for their enthusiastic help and support!

Thank you for your financial support for this project.

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**Author's Brief Introduction**

The year \* month \* day comes from \* year \* month \* day.

The students were admitted to \* University \* Department \* specialty \* and graduated from \* University \* year \* month undergraduate course and received \* bachelor's degree.

He studied in \* University \* College (department) \* subject and obtained \* master's degree.

He studied in \* University \* Department \* discipline and obtained \* doctorate degree.

Award winners:

Working experience:

**(Times New Roman, 12pt; Paragraph Line Spacing: 1.25 line, Indent the first line by 2 characters)**

**(The author's brief should generally include educational experience and work experience.)**