North China Electric Power University

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华北电力大学

学术硕士学位论文 (SimSun, 24pt, bold)

局部多孔质气体静压轴承关键技术的研究

(SimHei（黑体）, 22pt)

Research on Key Technologies of Partial Porous Externally Pressurized Gas Bearing

(Times New Roman 22pt, bold, If the title is too long, use a small 2pt font)

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学术硕士学位论

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硕士研究生	：	于梅
导　　师	：	□□□（副）教授
申请学位	：	**硕士
学科专业	：	
所在学院	：	电气与电子工程学院
答辩日期	：	2024年6月
授予学位单位	：	华北电力大学

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Thesis for the Academic Master's Degree

↑
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Research on Key Technologies of Partial Porous Externally Pressurized Gas Bearing

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Supervisor:	Prof.□□□
Academic Degree Applied for:	Master of
Speciality:	
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Date of Defence:	June, 2024
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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: font 宋体, size 12pt

or 小四, Paragraph Line, Spacing:20pt)

Abstract

(title: Font: Times New Roman, size: 18 pt, bold, middle)

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

(English abstracts should be consistent with Chinese abstracts and should be accurate in grammar and vocabulary. Keywords should be linked by commas.)

(Content and keywords: Times New Roman 12pt, Paragraph Line Spacing: 1.25 line)

Contents (Times New Roman, 18pt, bold)

(The chapter title is in bold, and the titles of the articles and sections are in Times New Roman 12pt, Paragraph Line Spacing: 1.25 line)

Chapter 1 Introduction

(Times New Roman, 18pt, Bold, placed in the middle; Paragraph Line Spacing:1.35 line, before 25pt, after 12pt)

1.1 Research Background

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

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, Paragraph Line Spacing:1.35 line, before 25pt, after 12pt)

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 Classification of Hydrostatic Bearing (Times New Roman, 12pt, Bold; Paragraph Line Spacing: 1.25 line, before 0.5 line)

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

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:

$$\phi = \frac{D_p^2}{150}\frac{\psi^3}{(1-\psi)^2} \tag{4-1}$$

$$C_2 = \frac{3.5}{D_p}\frac{(1-\psi)}{\psi^3} \tag{4-2}$$

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

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

ϕ——Characteristic permeability or intrinsic permeability, related to the structural properties of materials (m^2).

……

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.

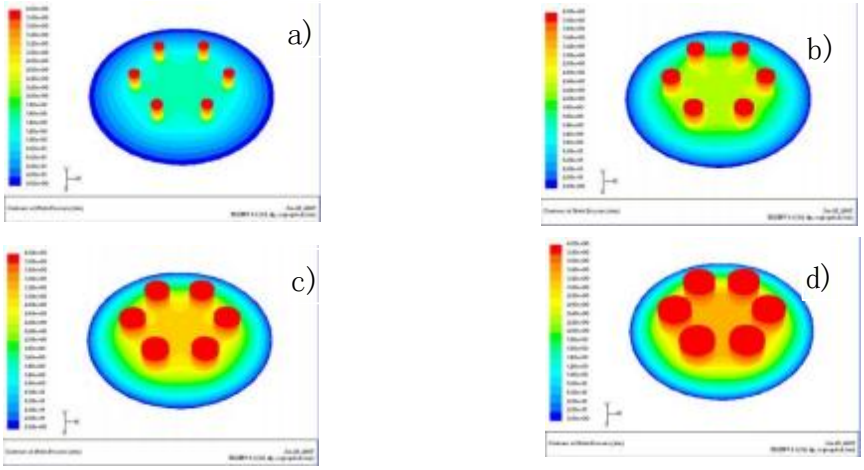
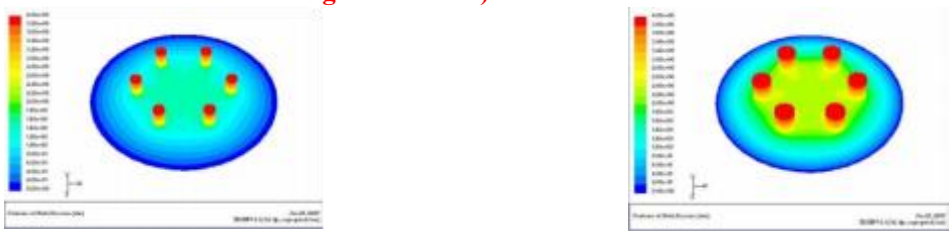


Fig.4-6 Pressure contour of bearing with partial porous plunger different radiuses

a) Pressure contour of bearing when R_3=1.5mm, b) Pressure contour of bearing when R_3=2.5mm

c) Pressure contour of bearing when R_3=3.5mm, d) Pressure contour of bearing when R=4.5mm

(Times New Roman 10.5pt. The title of the figure should be set at the buttom of figures. Before the title, tag need to be set, example: "Fig 4-6")
(You can also write in the following illustration)



a) Pressure contour of bearing when R_3=1.5mm

b) Pressure contour of bearing when R_3=2.5mm

c) Pressure contour of bearing when R_3=3.5mm

d) Pressure contour of bearing when R_3=4.5mm

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 No.1 (Temperature: T=16℃ Height: H=5.31mm)

Gas supply pressure Ps (MPa)	Flow measurement M'(m³/h)	Flow correction value M (m³/s) $\times 10^{-4}$	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	--

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"

……

...... 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 Specimen permeability test data

Gas supply pressure P_s (MPa)	Flow measurement M'(m^3/h)	Flow correction value M (m^3/s) × 10^{-4}	Pressure difference ΔP (Pa)	lgΔP	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
0.15	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
0.15	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
0.15	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
0.15	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
0.15	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
⋮					
0.3	0.097	0.167 47	196 900	5.294 24	-4.776 06

Table 6-1（continuation table）

Gas supply pressure P_s (MPa)	Flow measurement M' (m^3/h)	Flow correction value M (m^3/s) × 10^{-4}	Pressure difference ΔP (Pa)	lgΔP	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 words.

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

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[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.

[5] 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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Theses and other publications during the master's degree program

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]

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.

Note: If published academic papers are included in EI or SCI, please indicate the number of the papers included and the influencing factors of SCI papers. For academic papers received but not published, please indicate whether they are sources of EI or SCI.

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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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