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CCS Q30



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 43881-2024

**Test method for linear thermal expansion of low-expansion
glass - Laser interferometry**

低膨胀玻璃线热膨胀系数试验方法 激光干涉法

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Foreword

This document is in accordance with the provisions of GB/T 1:1-2020 "Guidelines for standardization work Part 1: Structure and drafting rules for standardization documents" Drafting: Please note that some of the contents of this document may involve patents: The issuing organization of this document does not assume the responsibility for identifying patents: This document was proposed by China Building Materials Federation: This document is under the jurisdiction of the National Technical Committee for Standardization of Industrial Glass and Special Glass (SAC/TC447): This document was drafted by: China Building Materials Science Research Institute Co., Ltd., Rainbow Group (Shaoyang) Special Glass Co., Ltd., Bengbu China Optoelectronics Technology Co., Ltd., China National Testing Holding Group Co., Ltd., Beijing Space Electromechanical Research Institute, CNBM Quzhou Kingland Quartz Co., Ltd., Beijing Sinoma Artificial Crystal Research Institute Co., Ltd: The main drafters of this document are: Nie Lanjian, Zhang Chenyang, Hui Shuang, Xue Xinjian, Cao Zhiqiang, Sun Shijun, Zhang Zemin, Chen Yaxin, Fu Bo, Wang Jingxia, Liu Ruiwang, Zhou Jianxin, Fan Shigang, Yang Xuedong, Qin Jianhong, Shao Zhufeng, Wang Hui, Wang Lei, Jia Yanan, Shen Yuguo, Li Na, Wang Hongjie, Hua Ning, Sui Meishen: Test method for linear thermal expansion coefficient of low expansion glass Laser interferometry

1 Scope

GB/T 43881-2024 specifies how the thermal expansion of ultra-low-expansion glass is measured, and it needs laser interferometry because ordinary dilatometry is not good enough. Low-expansion glass-ceramics are the material of large telescope mirror blanks,

photolithography stages and precision metrology components, and they are chosen because their expansion coefficient is near zero - sometimes a few parts per billion per kelvin. Measuring a number that small means detecting a length change of nanometres over a specimen tens of millimetres long, at which point the expansion of the measuring apparatus itself is larger than the quantity being measured. Interferometry avoids that by measuring the specimen's length directly in wavelengths of light rather than through a mechanical linkage. This document specifies the principle, the test apparatus, the specimens and the test method for determining the linear thermal expansion coefficient of low-expansion glass by laser interferometry. Under ICS 81.040.01 and CCS Q30, it is written for the producers of low-expansion glass and glass-ceramics, for optical and semiconductor equipment makers, and for metrology laboratories.

This document specifies the principle, test device, test specimen, test strips and test methods for testing the linear thermal expansion coefficient of low expansion glass using the laser interferometry method: parts, test procedures, data processing, and test reports: This document is applicable to low expansion glass (such as low expansion quartz glass, low expansion microcrystalline) with a linear thermal expansion coefficient of no more than $10^{-7}/^{\circ}\text{C}$ Glass and high-purity quartz glass, etc.) linear thermal expansion coefficient testing, other linear thermal expansion coefficient materials are used for reference:

2 Normative references

The contents of the following documents constitute the essential clauses of this document through normative references in this document: For referenced documents without a date, only the version corresponding to that date applies to this document; for referenced documents without a date, the latest version (including all amendments) applies to This document:

GB/T 1216 Outside Micrometer

GB/T 21389 Vernier, dial and digital calipers

3 Terms and definitions

The following terms and definitions apply to this document: 3:

1 Low-expansion glass Within a certain temperature range (the maximum temperature in this document does not exceed 500°C), the average linear thermal expansion coefficient is not greater than $10^{-7}/^{\circ}\text{C}$ Glass:

4 Principle

Based on the low expansion glass sample and reference material under heating conditions, the Michelson laser interferometer thermal expansion instrument was used to measure the

low expansion glass sample: The length change of the sample is calculated based on the change of the interference fringes, and then the average linear heat is calculated based on the temperature range and instantaneous temperature: Coefficient of expansion or instantaneous coefficient of linear thermal expansion at a specific temperature:

5 Experimental equipment

1 Michelson Laser Interferometer Dilatometer 5:1:

1 Sample holder, sample ejector rod, reference ejector rod The sample holder, sample push rod and reference push rod are all made of the same grade of annealed quartz glass: The sample push rod and the reference push rod are both hollow structures with a vacuum inside: The inner wall at the lower end of the push rod is plated with a reflective layer: