

专注于高性能玻璃纤维，提供优质解决方案  
Focus On High Performance Fiberglass And Provide Superior Solutions

# 用 巨石集团高性能玻璃纤维的特性与应

## The Characteristics and Applications of High Modulus and High Strength Fiberglass E7



费其锋 Jeff Fei  
巨石产品研发中心 Jushi R&D Center





1

巨石集团简介  
Jushi Group Profile

2

E7, 巨石新一代高性能玻璃  
Jushi New Generation High-performance Glass E7

3

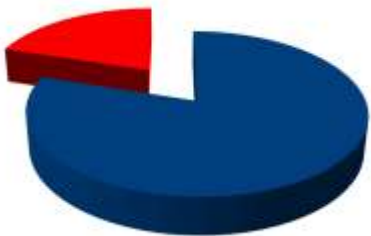
E7-380, 高性能玻璃和浸润剂的完美组合  
Optimal Combination of E7-glass and 380 Sizing

4

E7产品优势与应用  
The Advantages and Applications of E7 Products



- The world's largest fiberglass manufacturer, Annual capacity over 1,000,000 tons.
- Total assets of 17.8 billion yuan, 8,000 employees.
- Five production bases (Tongxiang, Jiujiang, Chengdu, South Africa, Egypt)
- Market Share



Global 1/5

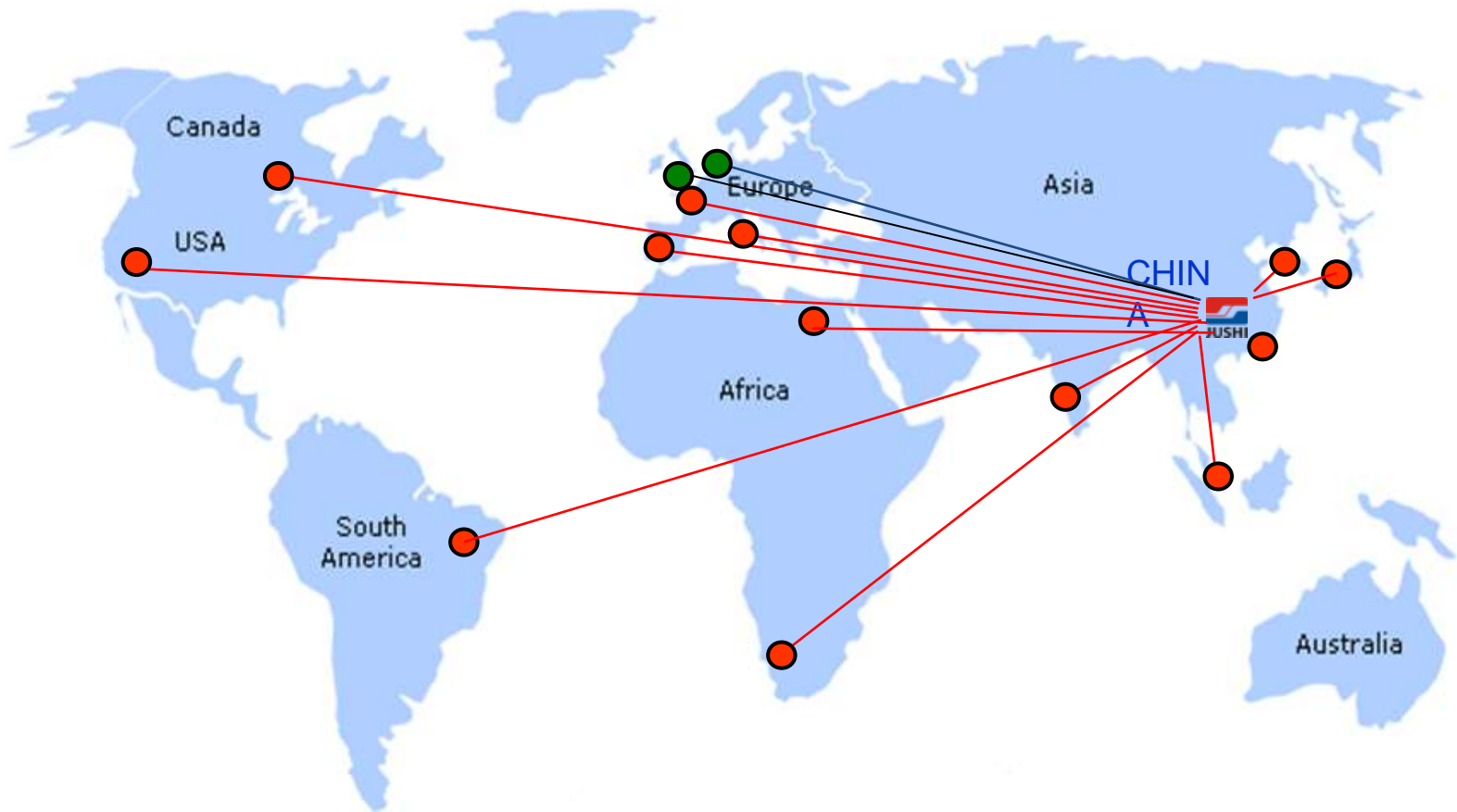


Domestic 1/3





## Marketing Network



Headquarters



Overseas subsidiary

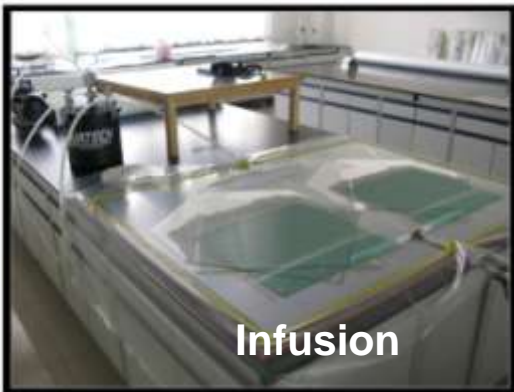


Exclusive distributor



- **Jushi has a National-Level Enterprise Technology Center and operates a distinguished Post-Doctoral program.**
- **Certified by both China National Accreditation Board for Laboratories (CNAS) and GL.**







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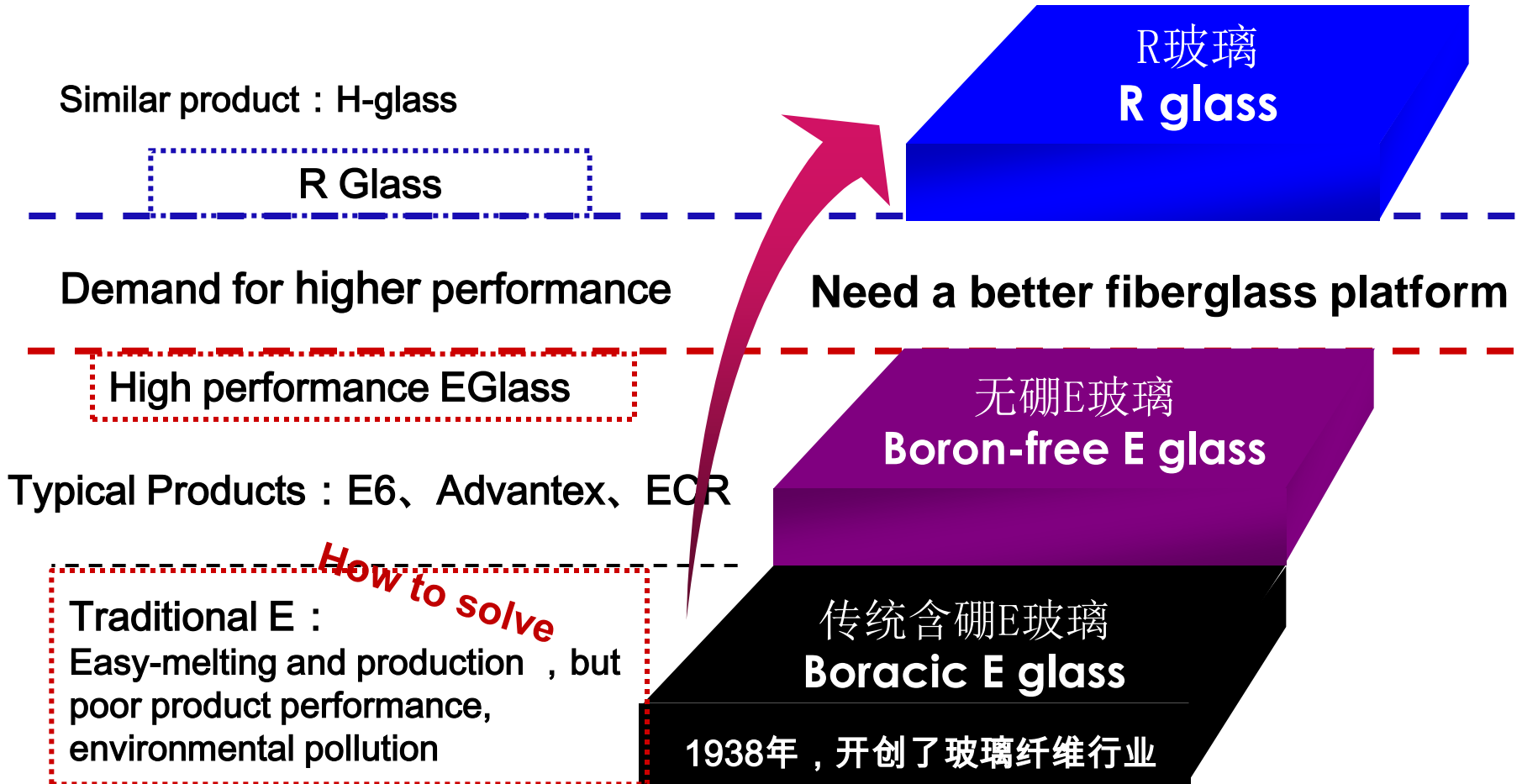
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E7产品优势与应用  
The Advantages and Applications of E7 Products



## A Better One...

High-end application : **E7**







## 何谓E7玻璃纤维?

= 高模量高强度R玻璃

= 无硼化环保玻璃

## What is E7 fiberglass ?

R glass with high modulus and strength

Boron-free glass

## According to ISO 2078-93

Table 1

| Type | General indications                              |
|------|--|
| E    | for general purposes; good electrical properties |
| D    | good dielectric properties                       |
| A    | high alkali content                              |
| C    | chemical resistance                              |
| S    | high mechanical strength                         |
| R    | high mechanical strength                         |
| AR   | alkali resistant                                 |
| E-CR | for use in acid environments                     |





## ■ Glass Physical Properties

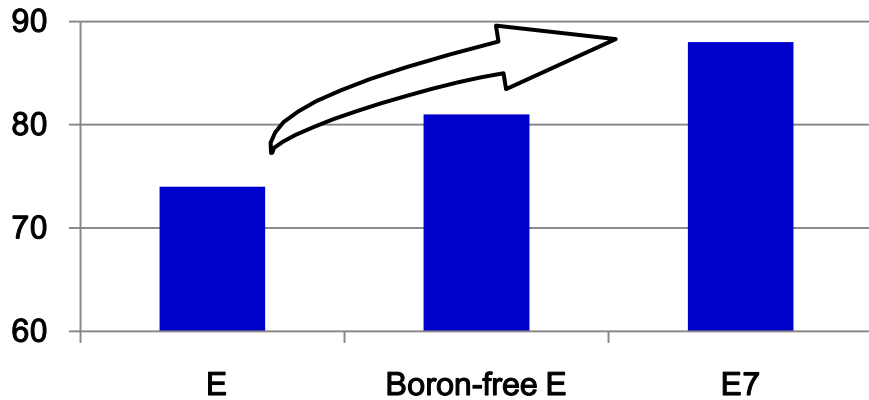
| 项目<br>Items             | 方法<br>Method           | 单位<br>Unit        | E7    | E glass | Boron-free<br>E glass |
|-------------------------|------------------------|-------------------|-------|---------|-----------------------|
| 密度<br>Density           | ASTM1505               | g/cm <sup>3</sup> | 2.58  | 2.60    | 2.65                  |
| 折射率<br>Refractive Index | 油浸法<br>Immersion       | /                 | 1.562 | 1.566   | 1.566                 |
| 介电常数<br>Permittivity    | ASTMD150               | /                 | 7.0   | 6.7     | 7.0                   |
| 弹性模量<br>Modulus         | 声波法<br>Acoustic Method | GPa               | 88    | 74      | 81                    |
| 比模量<br>Specific Modulus | /                      | 10 <sup>6</sup> m | 3.41  | 2.84    | 3.06                  |



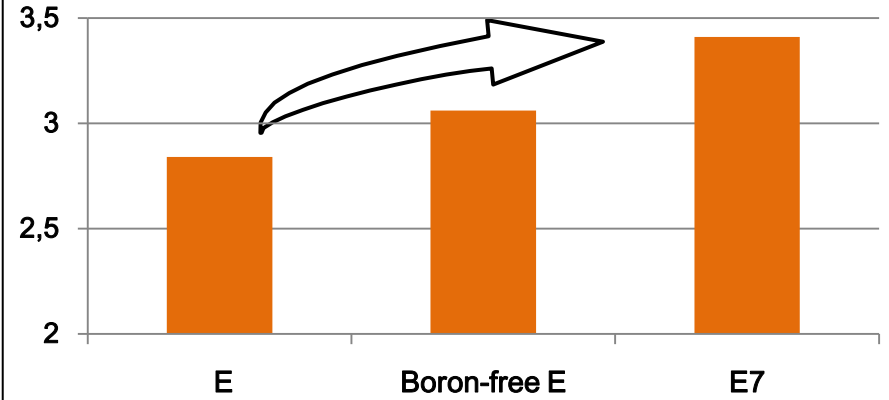
**E7玻纤更轻、更强、单位质量的性价比更高**

**E7 fiberglass: Lighter, Stronger, Better Cost Performance**

弹性模量 Modulus/GPa



比模量 Specific Modulus/ $10^6\text{m}$



|   | E7 对比 E | E7 对比 Boron-free E |
|---|---------|--------------------|
| 弹性模量提高比例%<br>Modulus raising ratio%         | 18      | 8.5                |
| 比模量提高比例%<br>Specific Modulus Raising ratio% | 20      | 11.5               |



## ■ Glass Thermal Properties

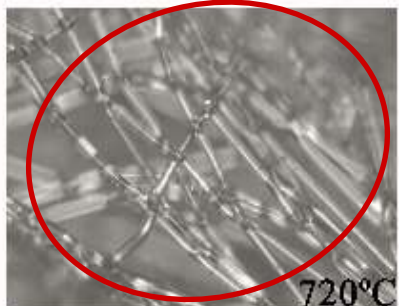
| 项目<br>Items                                 | 方法<br>Method | 单位<br>Unit      | E7                 | E glass | Boron-free<br>E glass |
|---|--------------|-----------------|--------------------|---------|-----------------------|
| 膨胀系数<br>Expansion Coefficient               | ASTM696      | $10^{-6}K^{-1}$ | 5.51               | 5.96    | 5.98                  |
| 软化点温度<br>Transition Temperature             | ASTMC338     | °C              | 921                | 842     | 902                   |
| 评估的安全使用温度<br>Heat-resistance<br>Temperature | /            | °C              | 760 Max            | 690 Max | 740 Max               |
|   |              |                 | Improved over 70°C |         |                       |



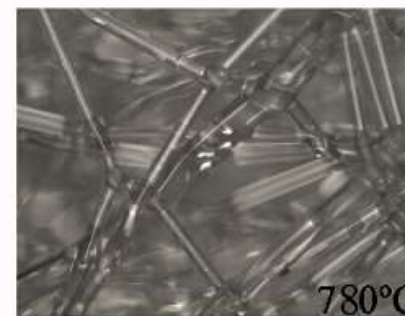
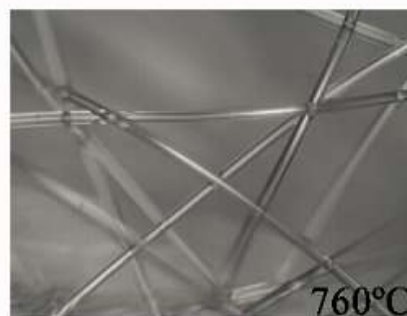
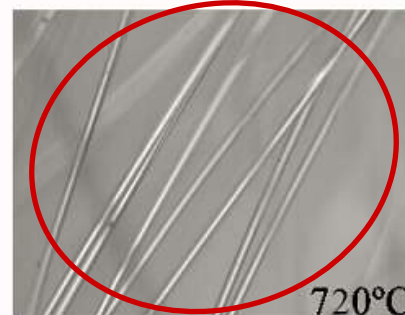
**E7玻纤耐热温度更高、热膨胀变形更小**

**E7 fiberglass : Higher Heat-resistance Temperature, Lower Transformation**

**E glass ( 6.5%B<sub>2</sub>O<sub>3</sub> )**

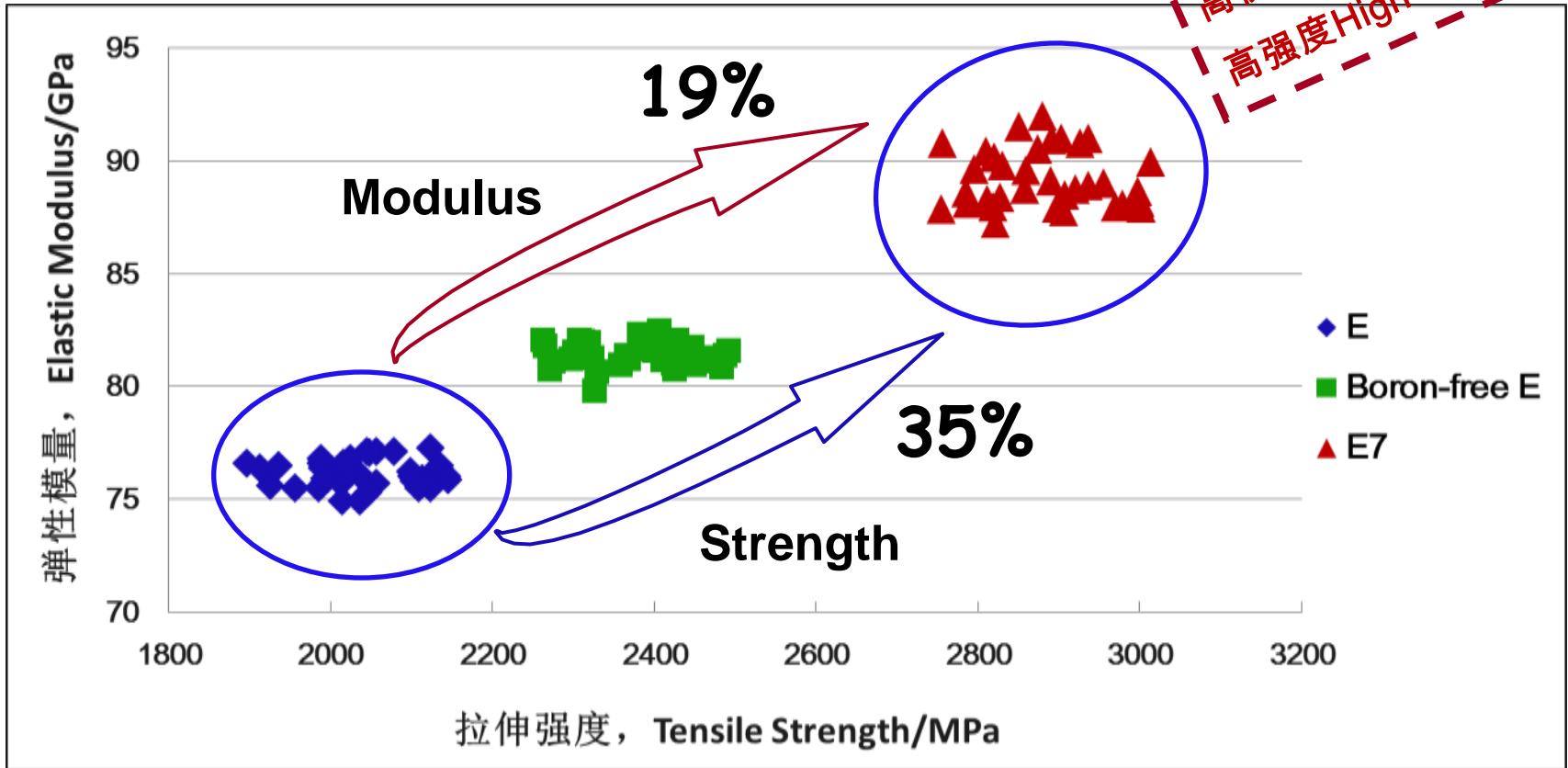


**E7 glass**





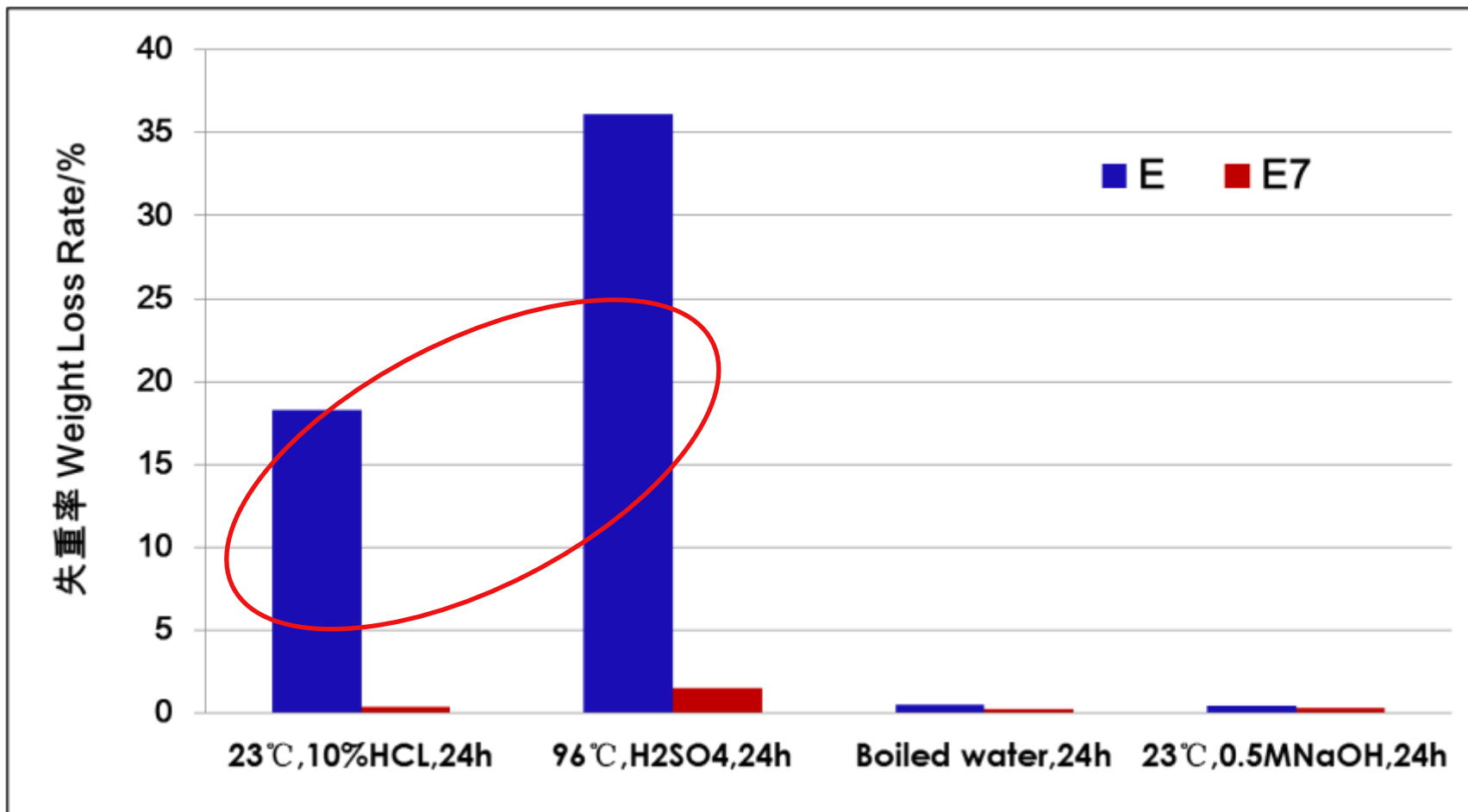
## ■ Impregnated Strand Mechanical Properties



The mechanical properties of impregnated yarn are tested by ASTM2343 standard.



## ■ Corrosion Resistance Properties



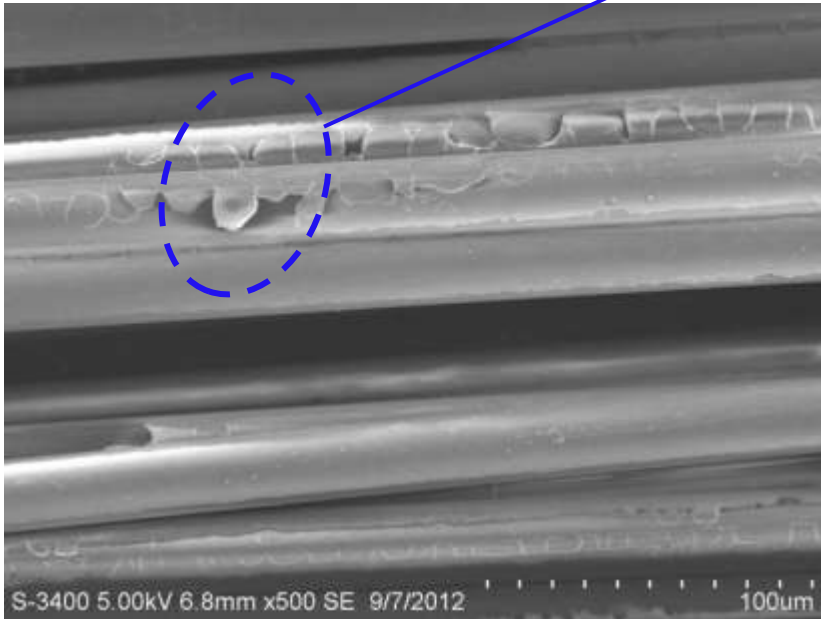


E7和传统E玻璃纤维的盐酸试验显微图 ( 23°C,10%HCL,24h )  
Micrographs on Hydrochloric Acid Test

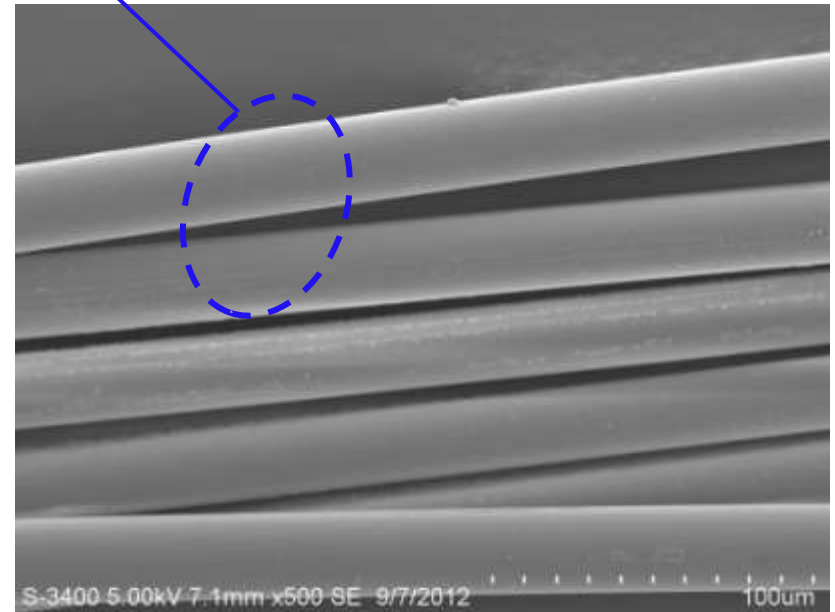
**E7玻纤更耐腐蚀**

**E7 fiberglass : Better Corrosion Resistance**

**E Fiberglass**



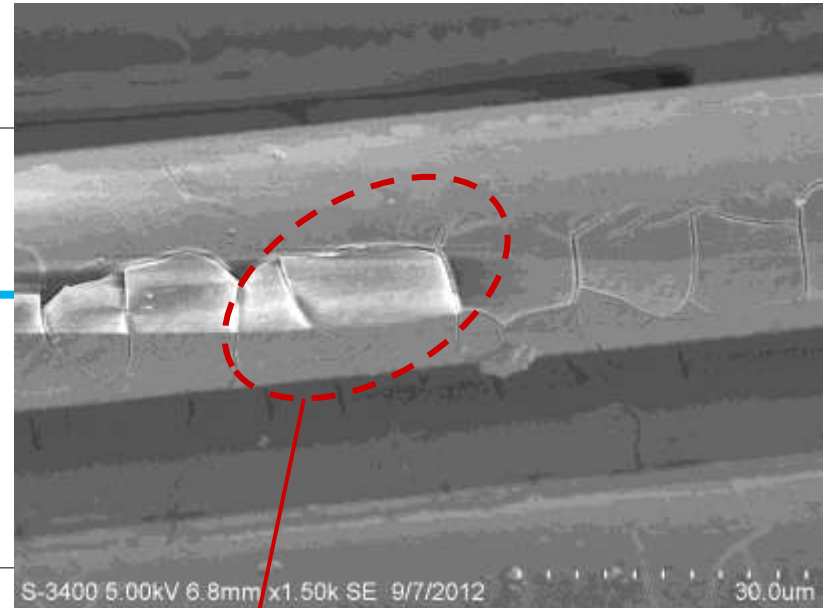
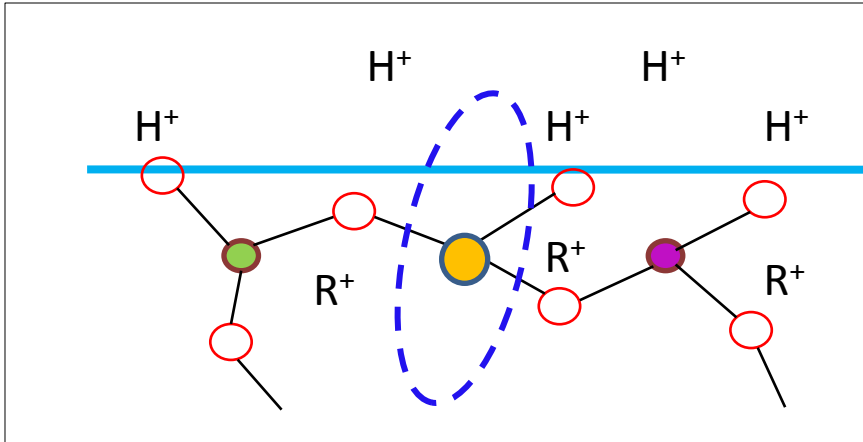
**E7 Fiberglass**







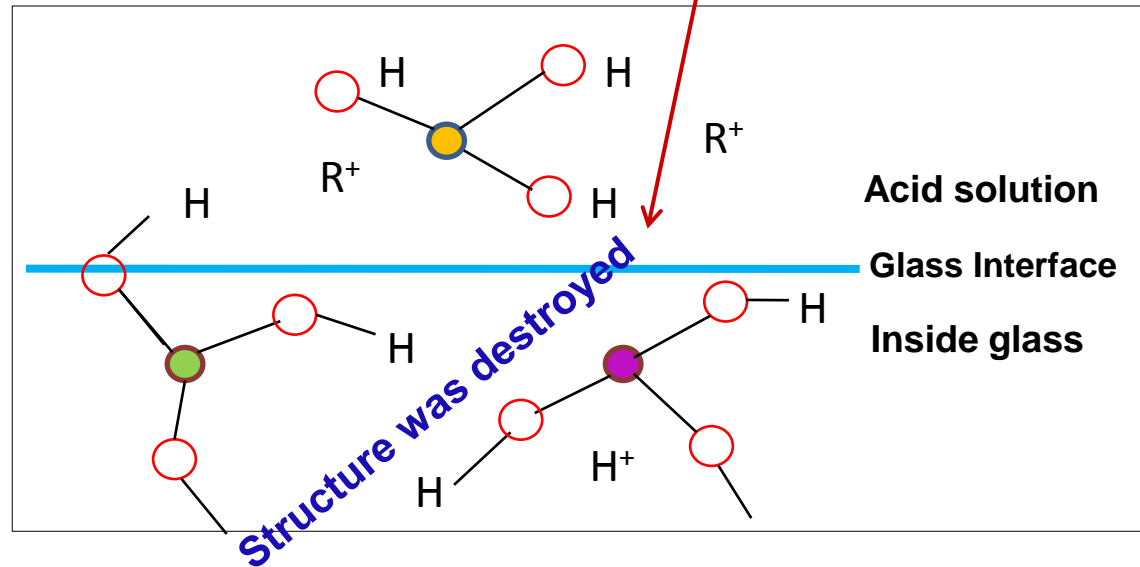
## Corrosion Mechanism



含硼的E玻璃  
在酸性介质中

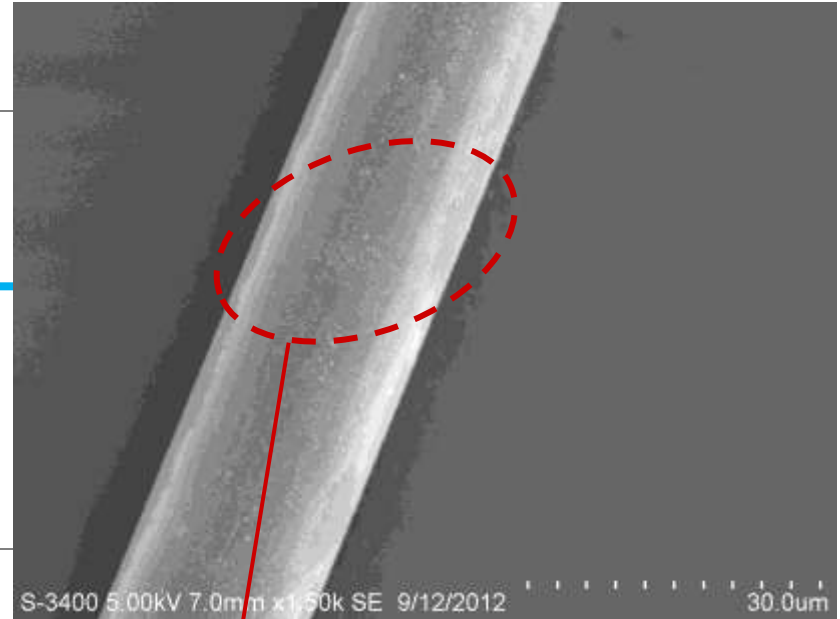
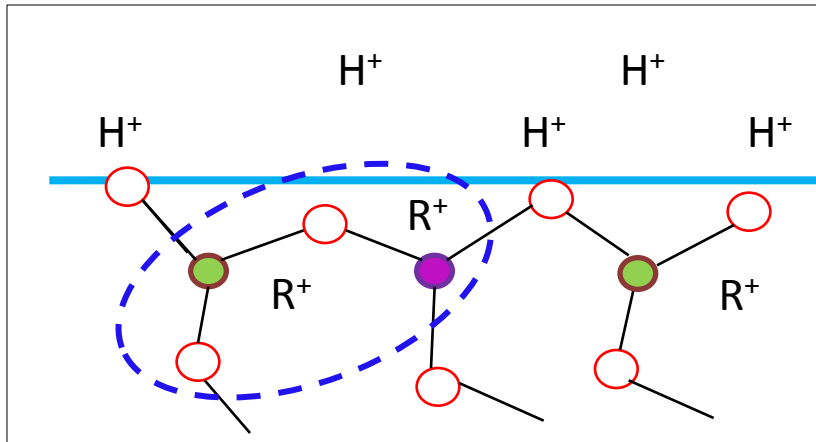


Boracic E glass  
in acidic medium






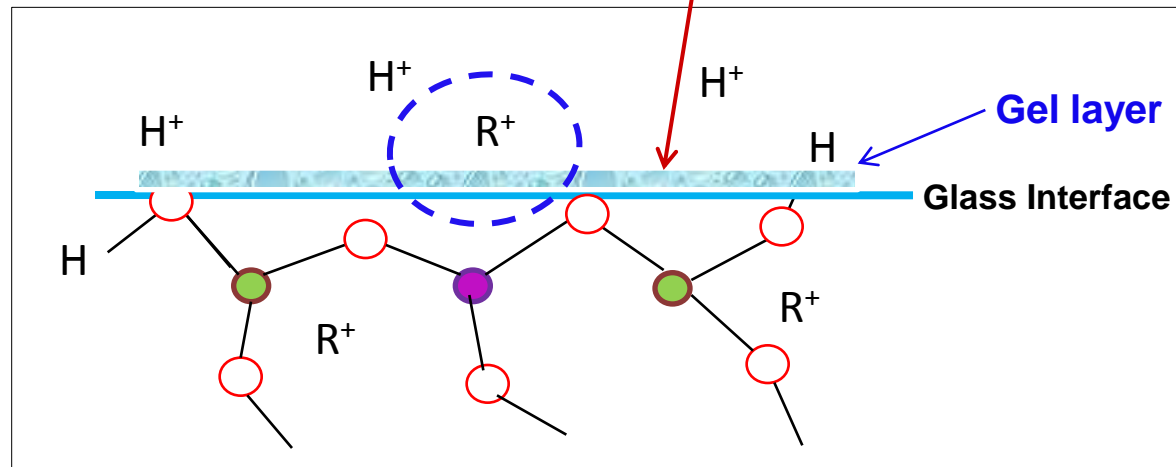
## Corrosion Mechanism



**E7玻璃**  
在酸性介质中



**E7 glass**  
in acidic medium





## ■ Outstanding Characteristics Summary of E7 Fiberglass

### □ With Breakthroughs In Properties :

- Up to **19% Increased** Modulus
- Up to **35% Increased** Strength
- Up to **70°C Increased** Temperature Resistance
- Superior Corrosion Resistance, **Equal to ECR**

### □ With Great Environmental Sustainability :

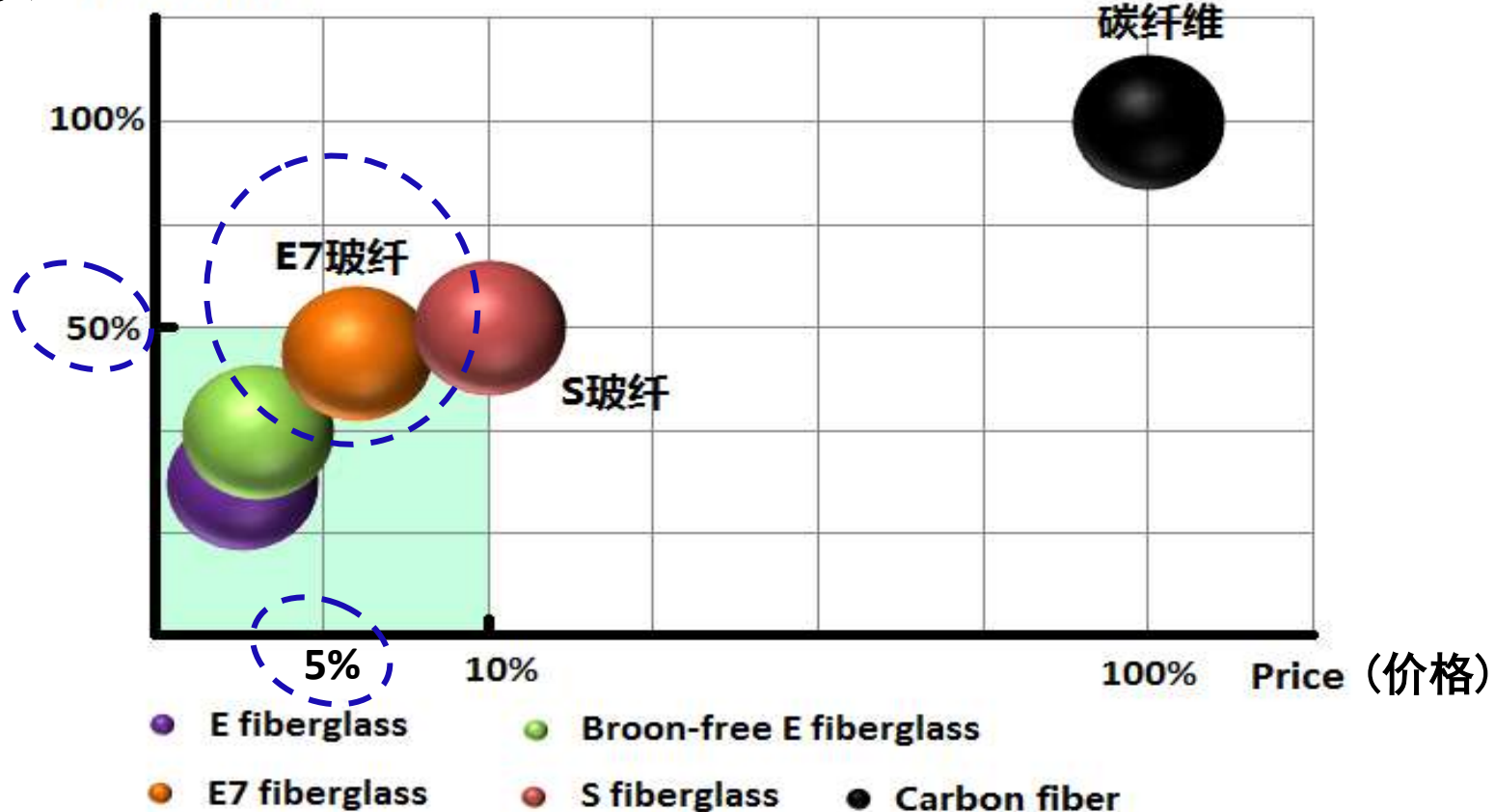
- No Boron
- Less CO<sub>2</sub>, NO<sub>x</sub>



与不同类型的纤维相比，E7玻纤具有极高的性价比

E7 fiberglass : Extraordinary High Cost-effectiveness

(产品性能) Performance





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## ■ Sizing Impacts

- Protects glass fibers, retaining strength that makes the composite solution possible.
  - Helps in processing for our customers' manufacturing productivity.
- 



**Unwinding**



**Fuzz**



**Impregnation**



- E7-380 based on E7 high performance glass, coated with 380 sizing especially designed for epoxy resin system.

## E7-380 Product

### 产品特点

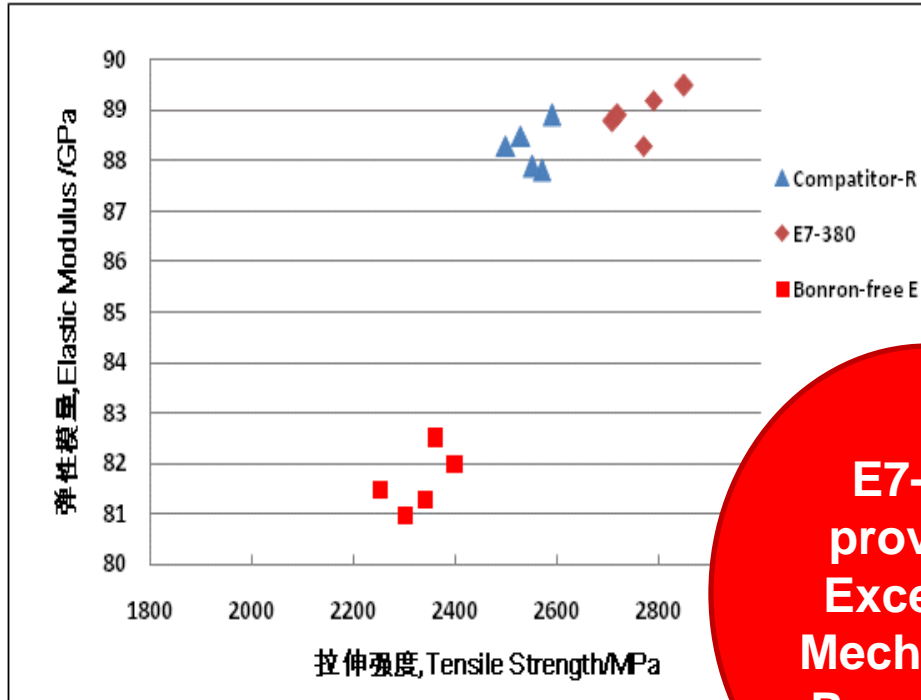
#### Product Characteristic

- Epoxy resin compatible
- Excellent process performance
- High modulus & strength
- Excellent fatigue performance

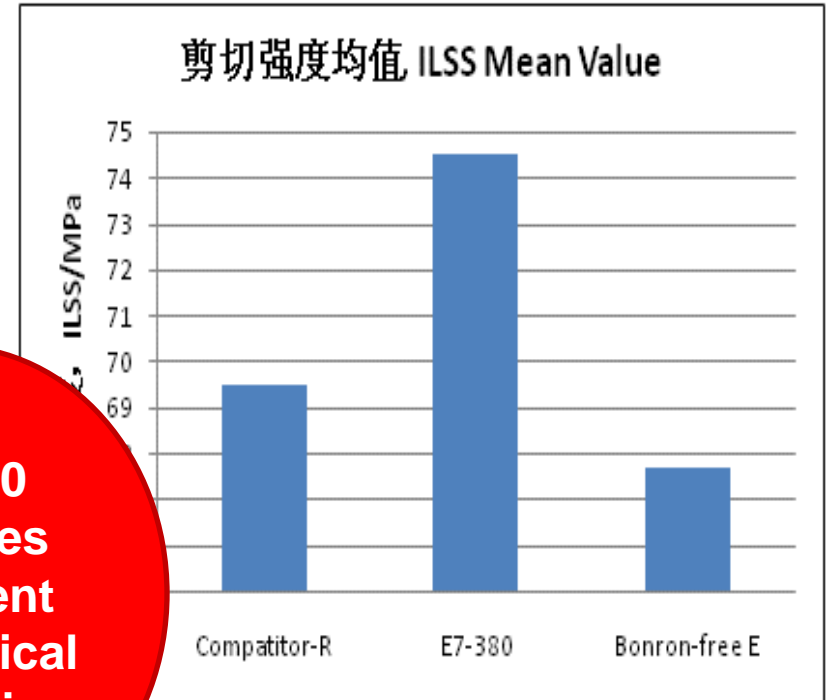




## Tensile properties



## Shear properties



**E7-380 provides Excellent Mechanical Properties**

Tested per ASTM D2343 standard, epoxy/amine resin system

Tested per ASTM D2344 standard, epoxy/amine resin system



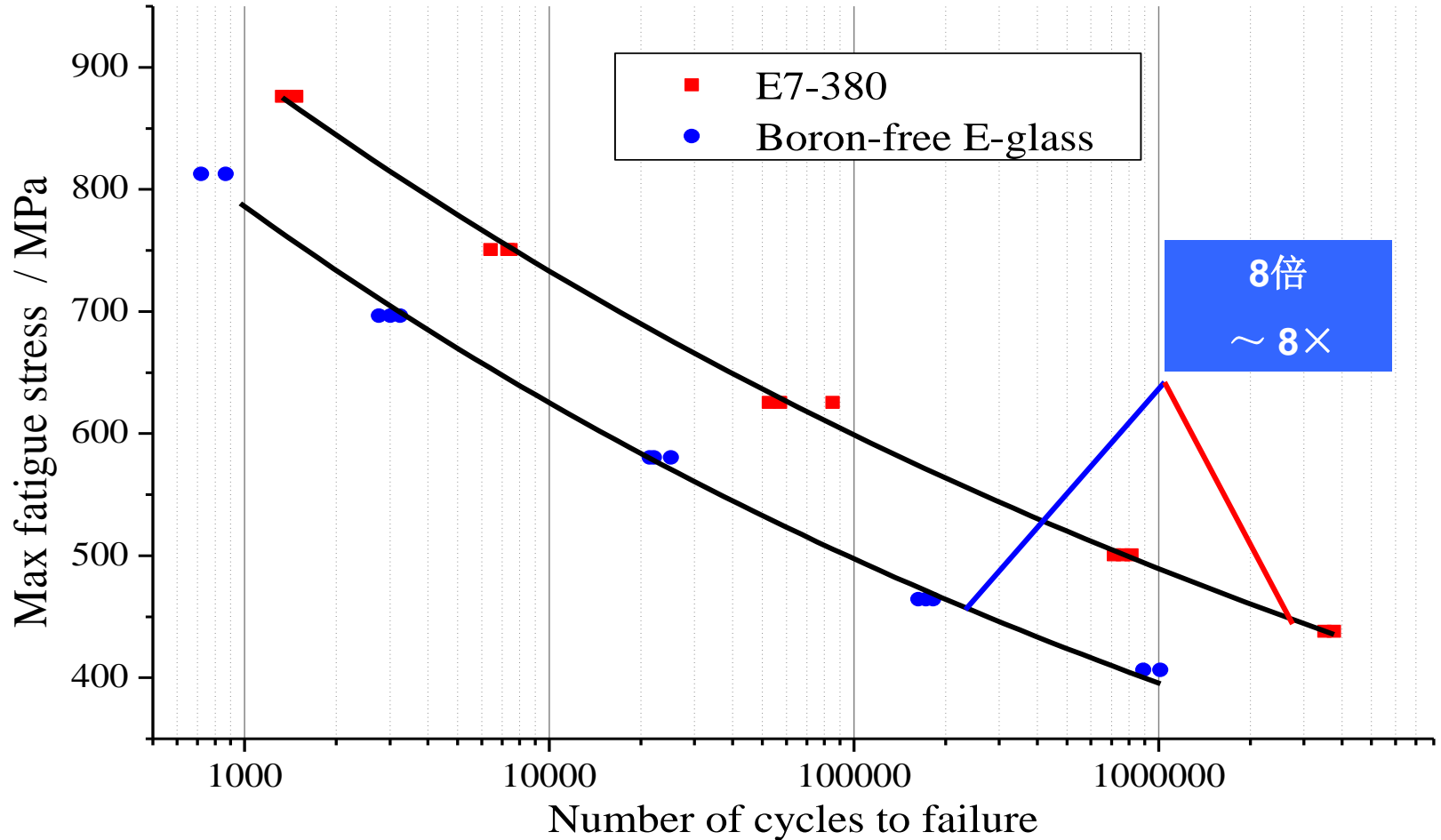


## E7-380 Static mechanical properties of UD1250 fabric epoxy laminate

| Property                | Unit | Standard | Boron-free E-glass | Competitor -R | E7-380        | E7 -380 vs Boron free E |
|-------------------------|------|----------|--------------------|---------------|---------------|-------------------------|
| 0° Tensile strength     | MPa  | ISO527-5 | <b>979.5</b>       | <b>1091.6</b> | <b>1292.5</b> | <b>32% ↑</b>            |
| 0° Tensile modulus      | GPa  | ISO527-5 | <b>43.1</b>        | <b>47.2</b>   | <b>47.8</b>   | <b>11% ↑</b>            |
| ±45° Shear strength     | MPa  | ISO14129 | <b>47.3</b>        | <b>47.6</b>   | <b>56.4</b>   | <b>19% ↑</b>            |
| ±45° Shear modulus      | GPa  | ISO14129 | <b>3.6</b>         | <b>3.5</b>    | <b>3.9</b>    | <b>8% ↑</b>             |
| 0° Compressive strength | MPa  | ISO14126 | <b>653.0</b>       | <b>841.2</b>  | <b>855.6</b>  | <b>31% ↑</b>            |
| 0° Compressive modulus  | GPa  | ISO14126 | <b>43.9</b>        | <b>48.7</b>   | <b>48.3</b>   | <b>10% ↑</b>            |

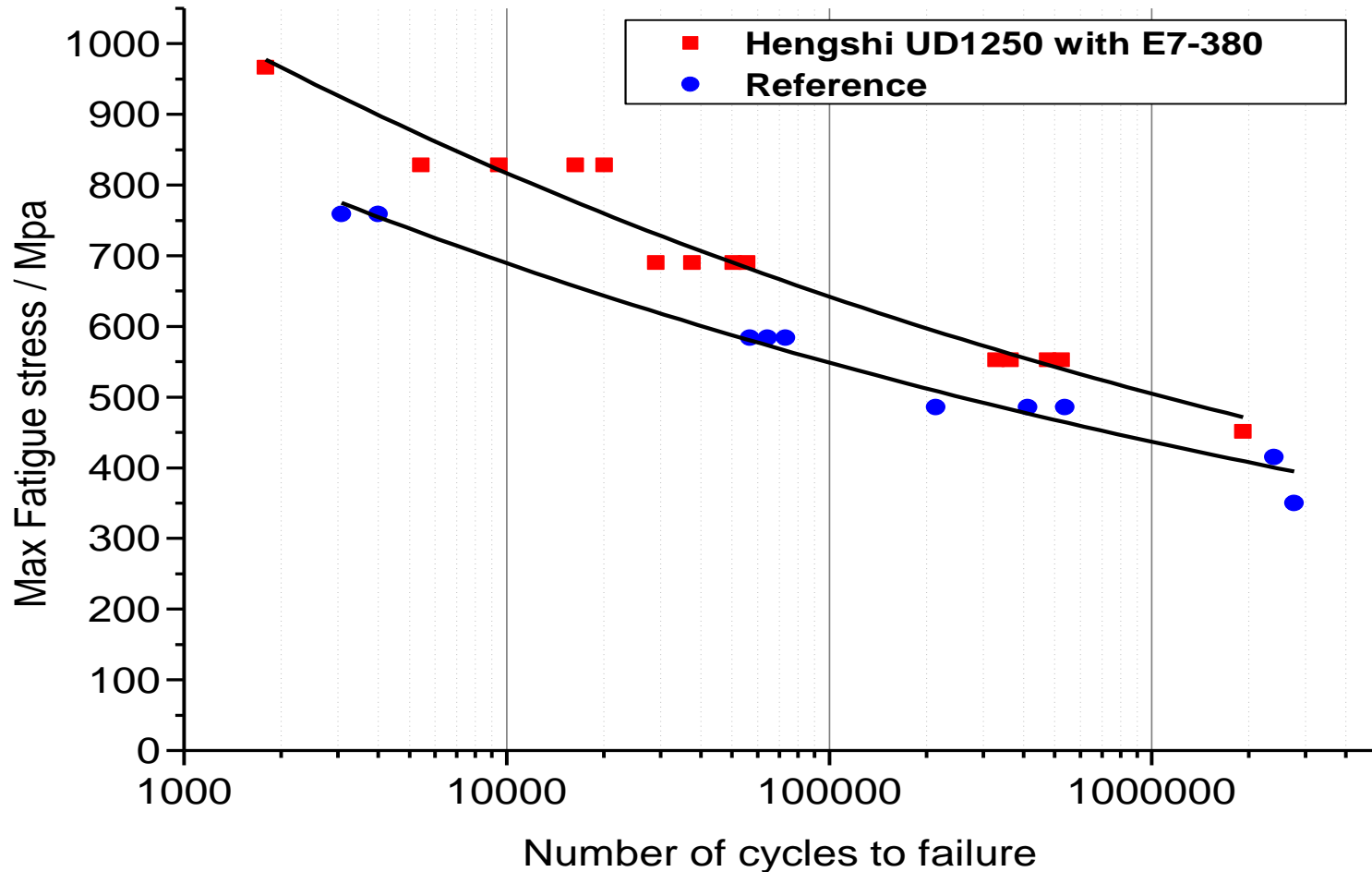


## T-T fatigue test on UD1200 epoxy laminate ( R = 0.1 )



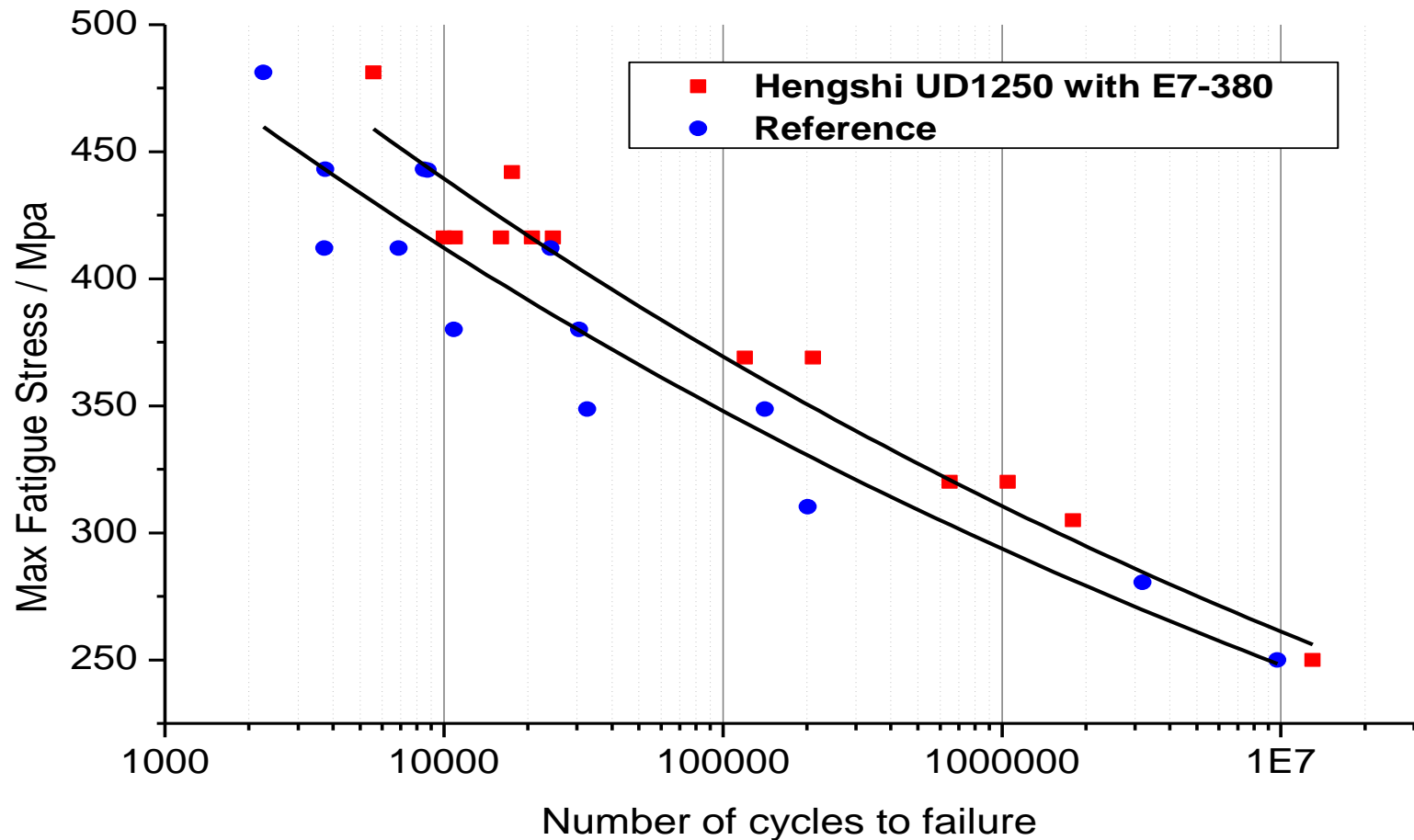


## T-T fatigue test on UD1250 fabric epoxy laminate ( R = 0.1 )





## T-C fatigue test on UD1250 fabric epoxy laminate ( R = - 1 )

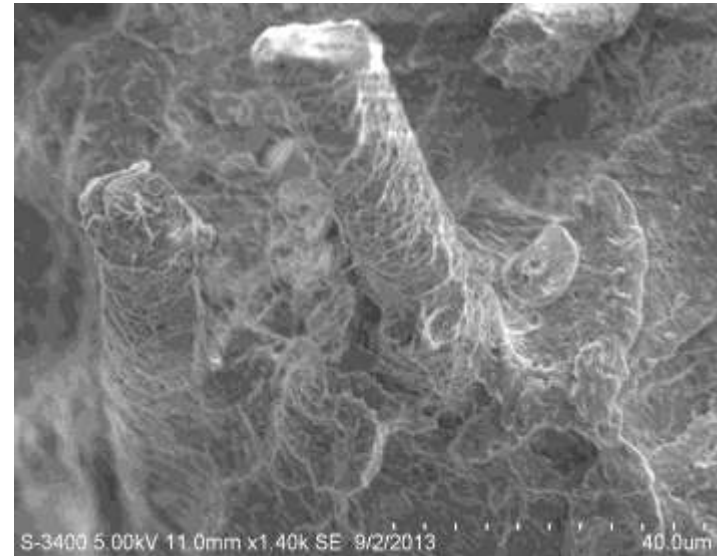




## ■ Summary of E7-380 Performance

▣ Compared with Boron-free E glass as well as competitors' similar products, E7-380 has obvious advantages:

- Higher Mechanical Properties of Impregnated Roving.
- Better Static Mechanical Properties of Epoxy Laminate.
- Excellent Fatigue Properties of Epoxy Laminate



**SEM Photograph of E7-380 composite**



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## Obvious Advantages in Wind Energy Fields



- Higher strength and stiffness make blades longer and lighter weight.
- Better anti-fatigue properties which can extend blades' service life.
- E7-380 has been fully recognized by global wind power customers, and has supplied large quantities to the market.



## Other Typical Application Fields



**Aerospace**



**High-pressure vessel**



**Transportation industry**



**Military**



**Pro-environment**



**Engineering**



专注于高性能玻璃纤维，提供优质解决方案  
Focus On High Performance Fiberglass And Provide Superior Solutions

# Thanks

欢迎提问  
Questions and Answers

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