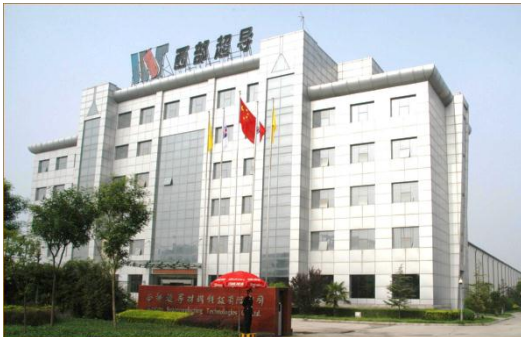


Introduction of WST



March, 2015

FCC-WEEK 2015



outline

1

Brief Introduction of WST

2

WST Products for ITER

3

WST Products for MRI/NMR

4

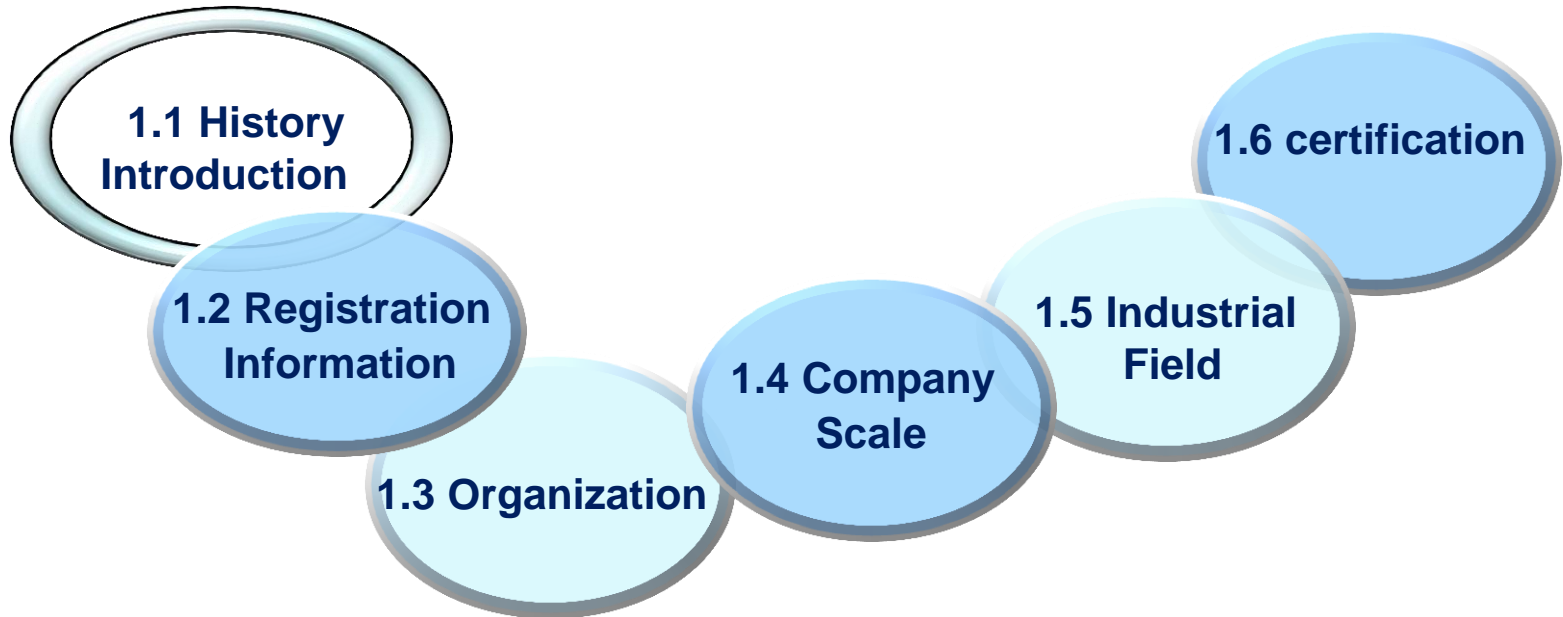
WST Products for HEP

5

Summary



1. General Introduction of the Company

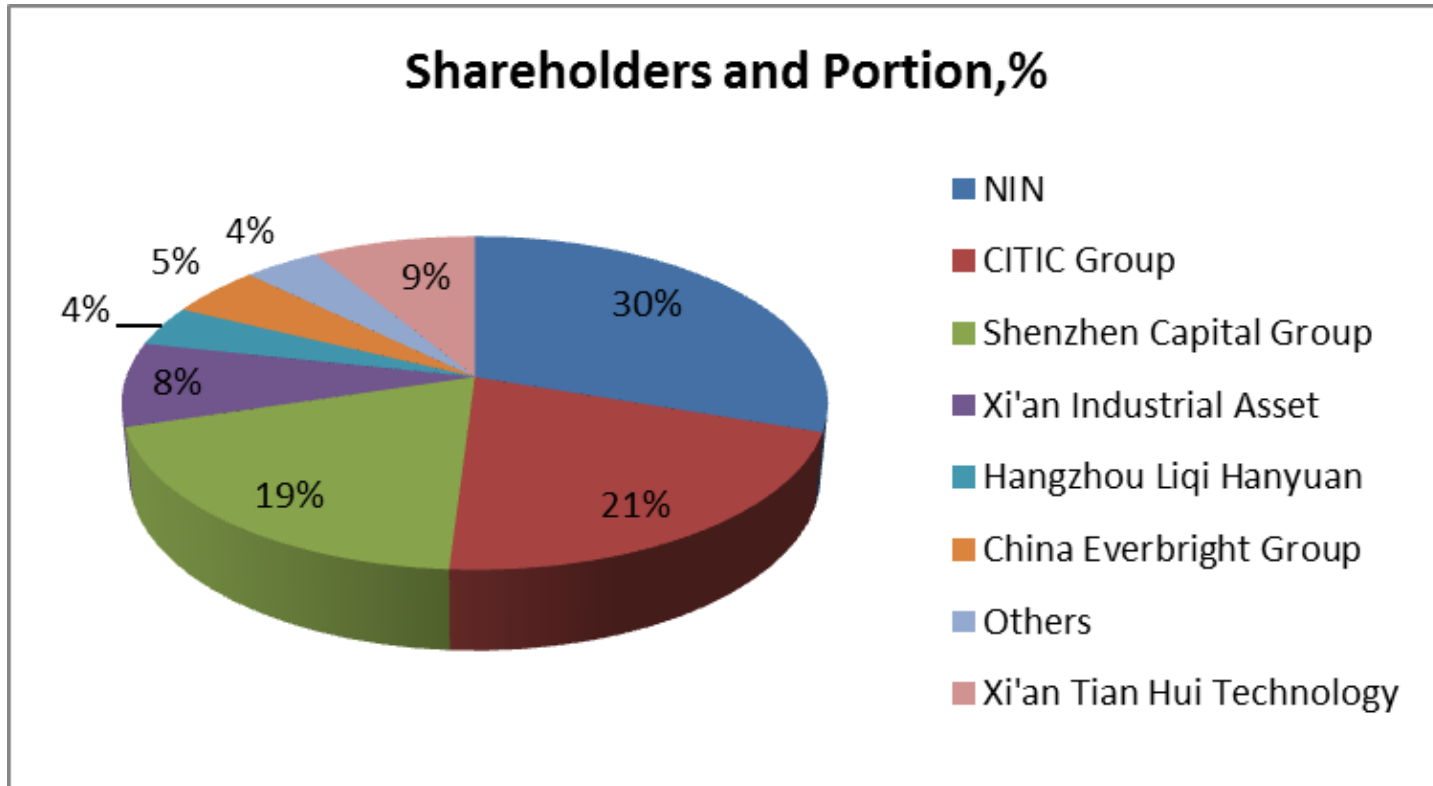


1.1 History Introduction

NIN = Northwest institute for nonferrous metal

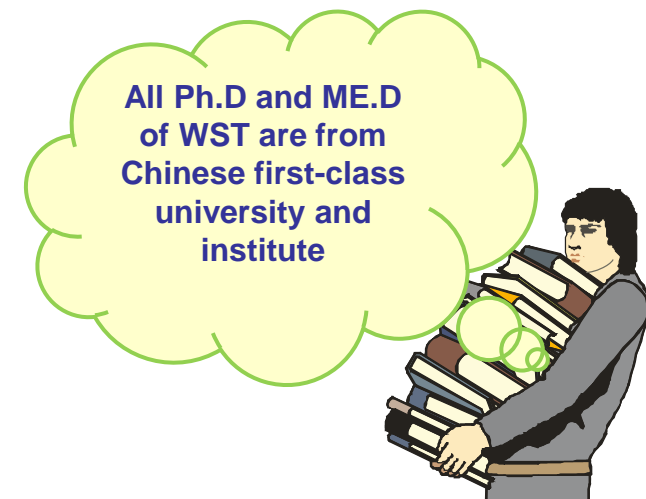
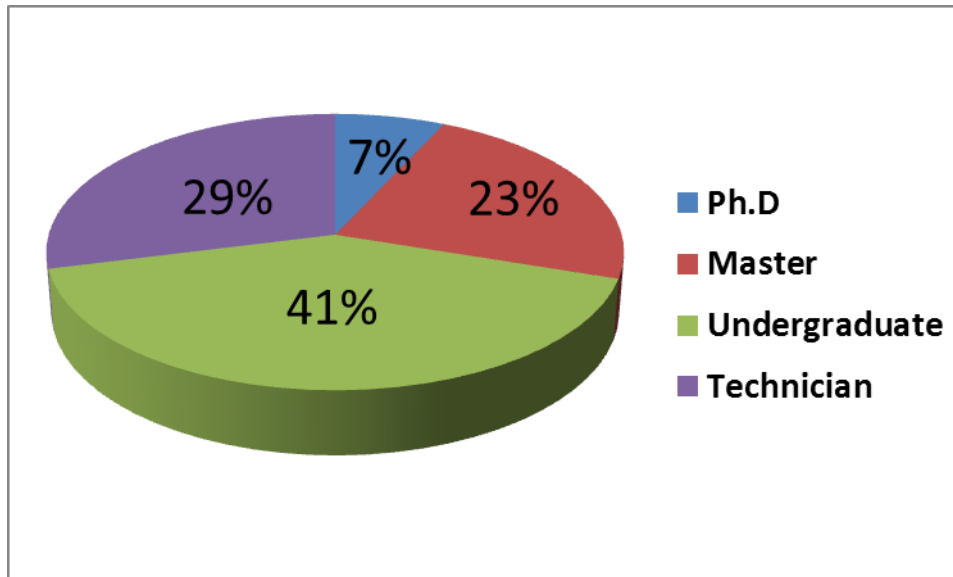
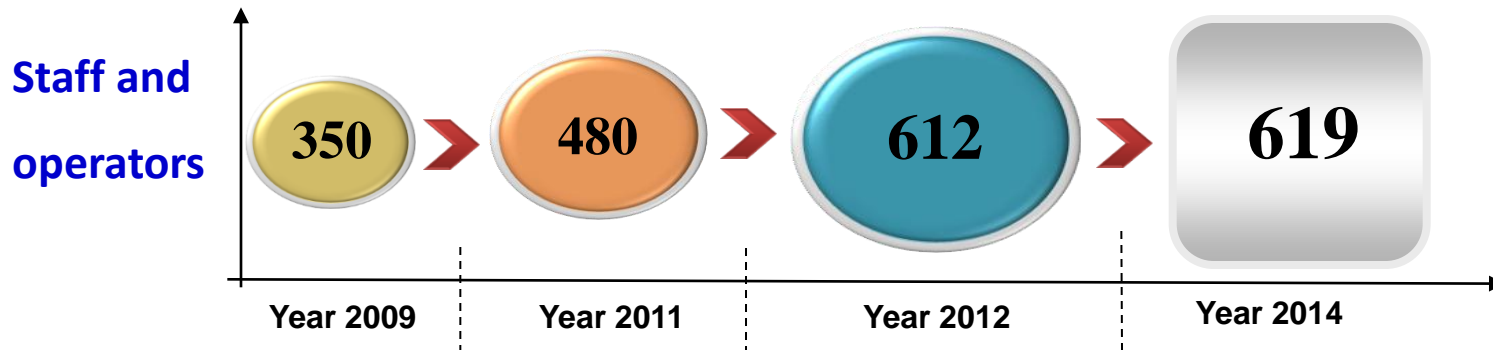
- ◆ R&D of NbTi materials (Ingot and wire) started in 1965.
- ◆ The first mono-filamentary NbTi wires were fabricated in 1967.
- ◆ The first multi-filamentary NbTi wires were prepared in 1972.
- ◆ J_c of NbTi wire reached 3450 A/mm² (4.2 K, 5 T) in 1980, the World Record.
- ◆ The first NbTi/CuNi wires for AC applications were made in 1987.
- ◆ The large size NbTi multi-filamentary wire with weight of 80 kg were prepared in 1995.
- ◆ Provided NbTi materials to superconductor producer:
 - Φ 20 mm NbTi bars to IGC in 1999 (MRI wires)
 - Φ 193.5 mm X 760mm NbTi billets to Alstom in 2001
 - Φ 29.4 mm NbTi bars to OXFORD in 2002 for MRI wires
- ◆ **WST was founded on February 28, 2003, and the main aim was ITER project.**
(NIN is the largest share holder)

1.2 Registration Information



The company invested by 10 more shareholders
the registered capital is **55 million USD**.

1.3 Organization : Personal and Educational Background



1.3 Organization : Management Team



Board of Director

Dr. Pingxiang ZHANG Chairman of the Board

Dr. Yong FENG General President

Vice G.P.

Dr.
Xianghong LIU

Vice G.P.

Dr.
Haiming LIU

Vice G.P.

Prof.
Changhu PENG

CFO

Dr.
Yidong LI

Vice G.P.

Prof.
Jinhua LUO

1.4 Company Scale- Area and Location

Area 1

Area 2

Area 3



- The 1st Area
- Location: Xi'an Economic-Technological Development Area
- Area: 82000 square meter



- The 2nd Area
- Location: Xi'an Economic-Technological Development Area
- Area: 110000 square meter



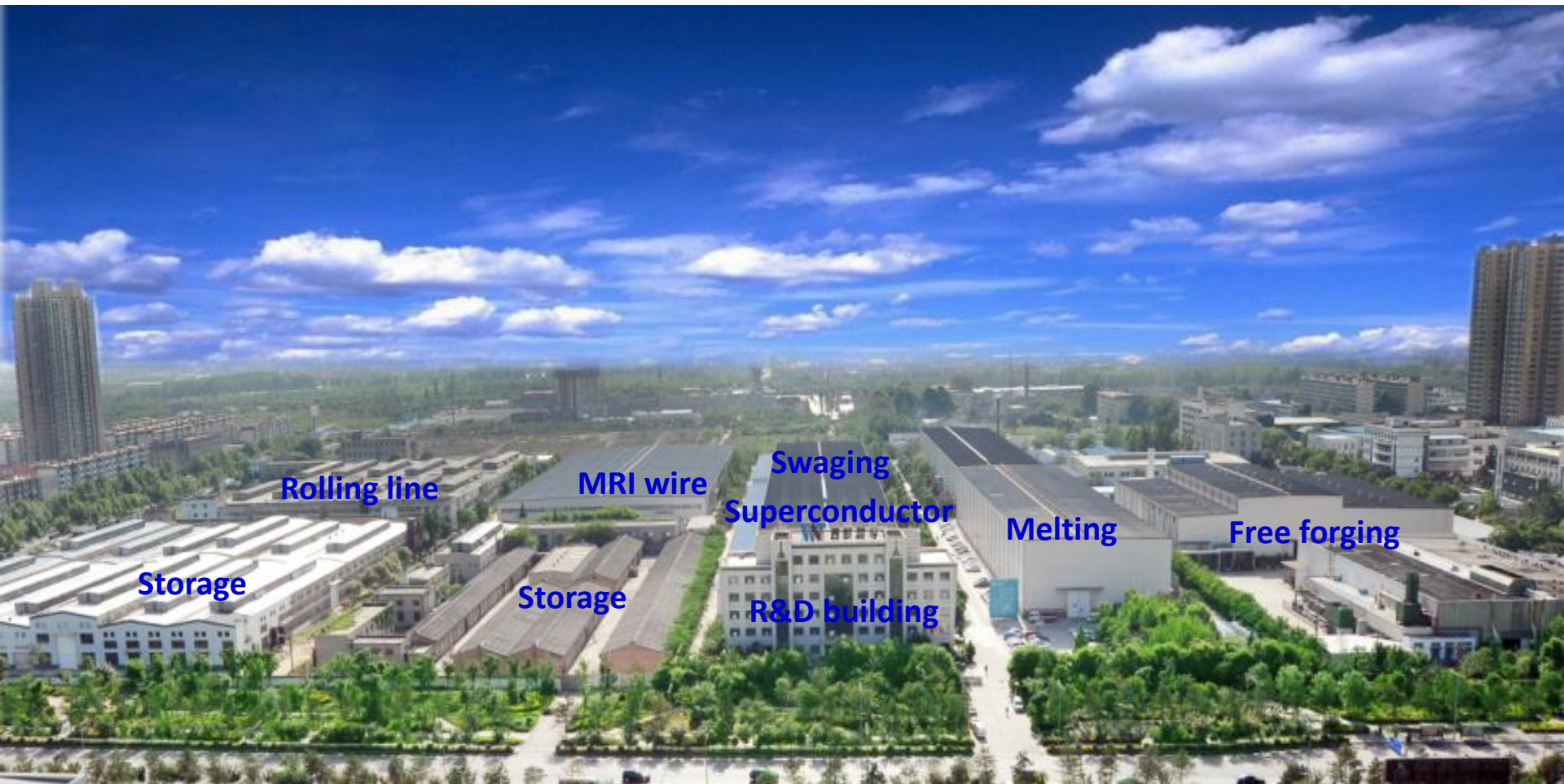
- The 3rd Area
- Place: Xi'an Jing Wei Industrial Park
- Area: 208000 square meter



Western Superconducting Technologies Co., Ltd.

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Layout of Area 1 and 2:



Storage

Rolling line

Storage

MRI wire

R&D building

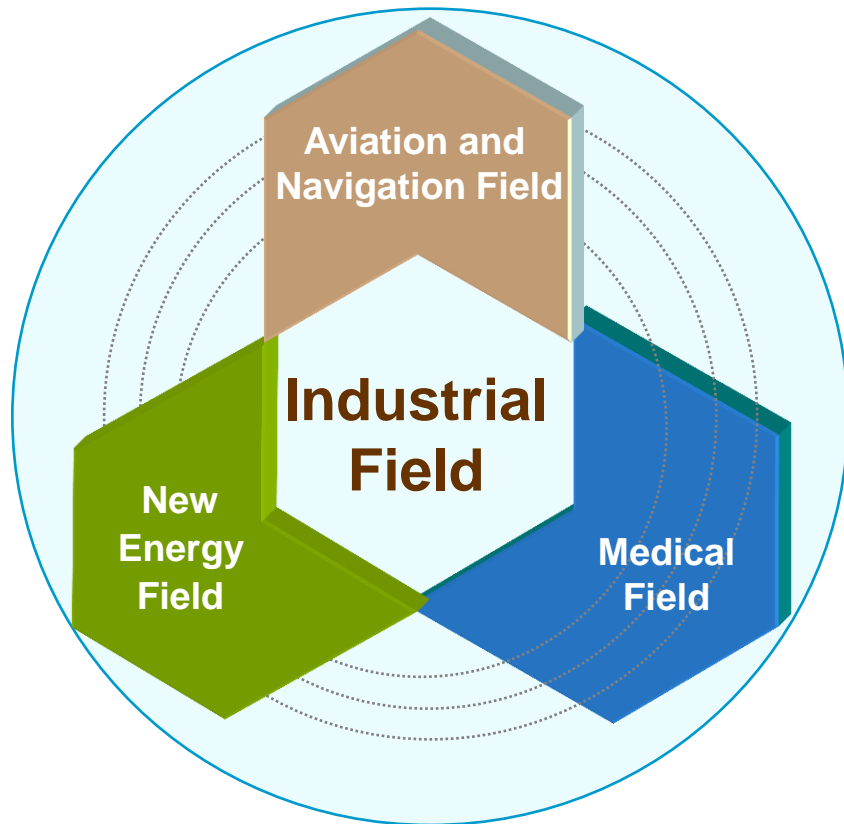
Swaging
Superconductor

Melting

Free forging

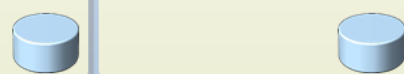
Capability of advanced Ti alloy and superconductor production lines: 6000 ton ingots of Ti alloy, 3000 ton rods of Ti alloy and 400 ton superconductor per year

1.5 Industrial Fields




Titanium Product

Aerospace and Aviation Field: bars, slabs rings wires	Medical Field implants glasses profiles
---	--

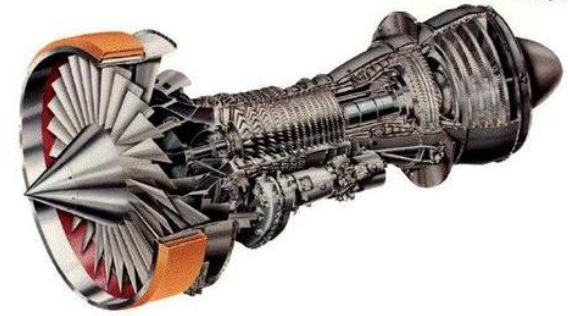


Superconducting Product

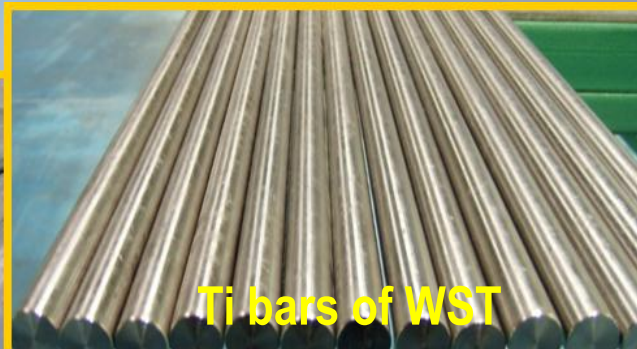
Energy and Transportation Field magnet coil magnet electromagnetic coil	Medical Field MRI coil etc.
--	---------------------------------------



Titanium Alloy in Aviation Field



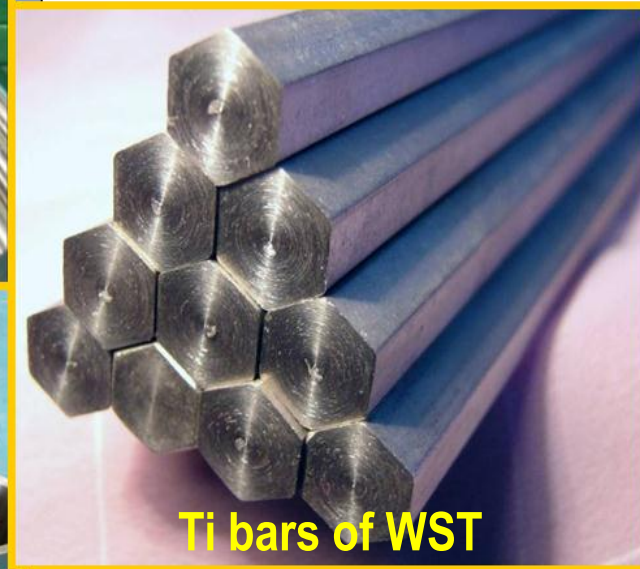
Ti bars of WST



Ti bars of WST



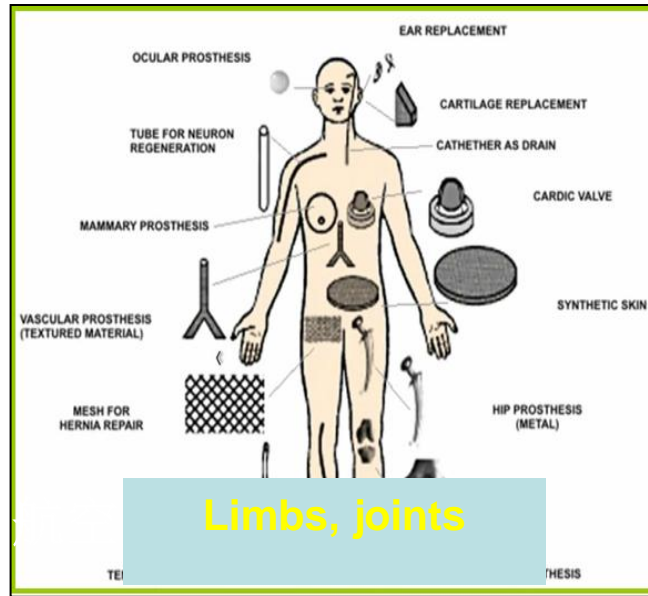
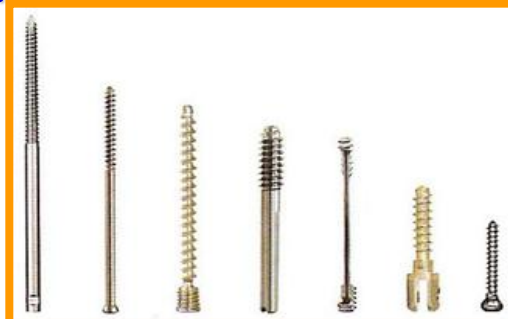
Ti rings of WST



Ti bars of WST

Titanium Alloy in Marine, Spaceflight and Medical Field

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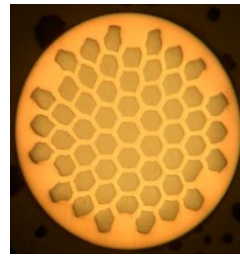
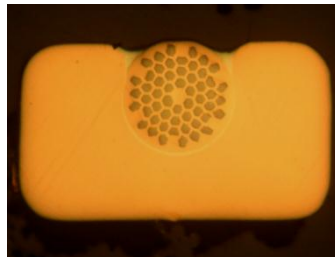
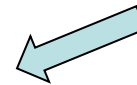
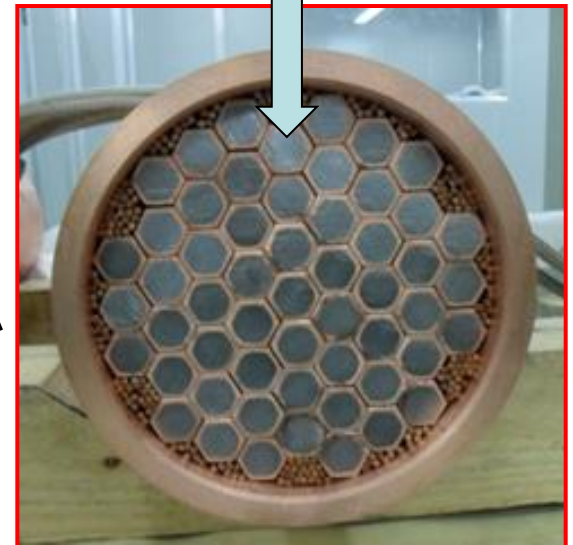




NbTi Alloy in Superconducting material Field

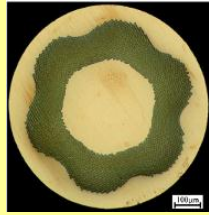


NbTi alloy billet/bar of WST

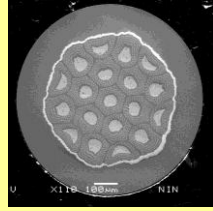


NbTi superconducting wire

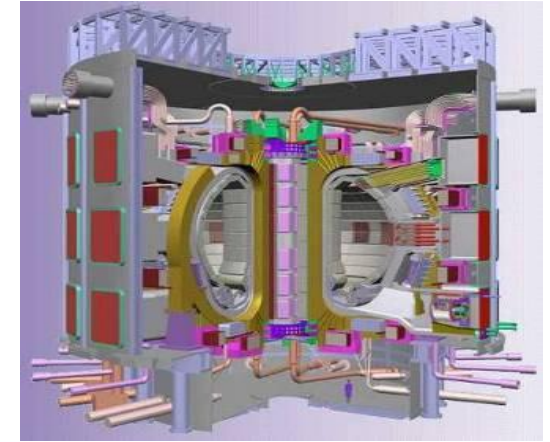
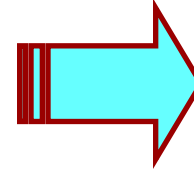
Low Temperature Superconducting Strands for ITER and MRI



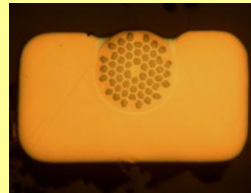
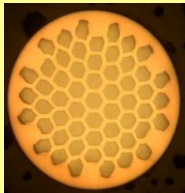
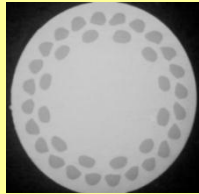
NbTi



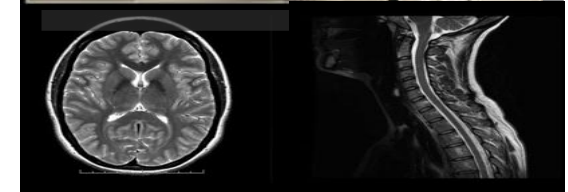
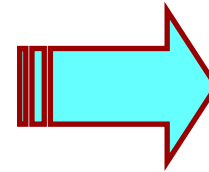
Internal Tin Nb₃Sn



ITER PROJECT

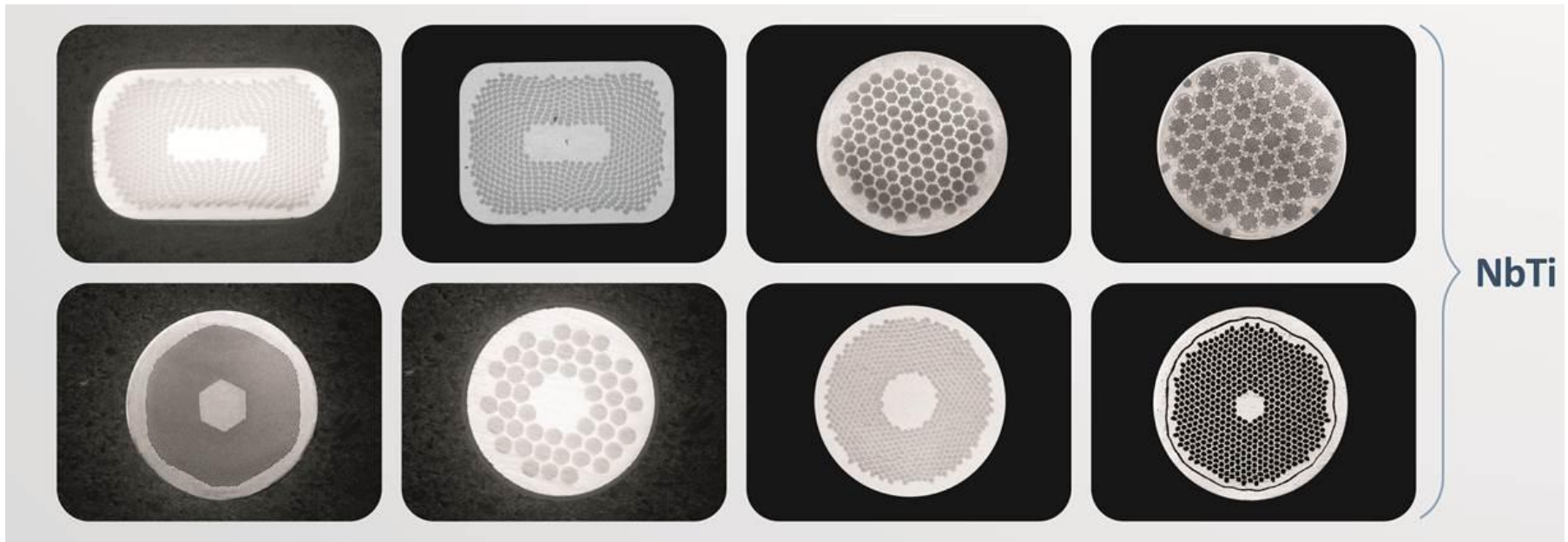
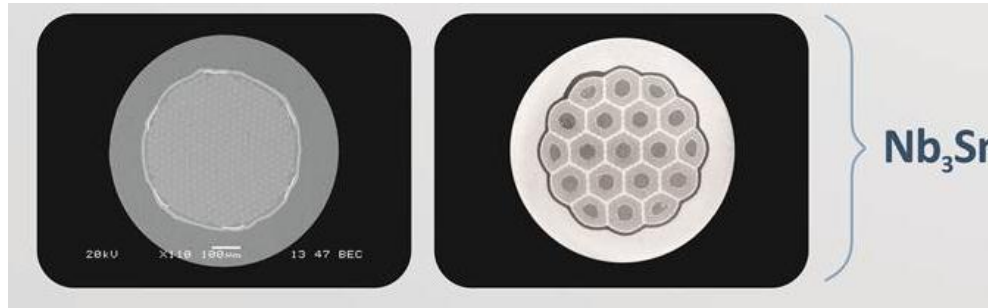


WIC or monolith wires



MRI

NbTi/Cu Superconducting Wires for customized





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1.6 Certification

格式: M1102R01

中国船级社质量认证公司
CHINA CLASSIFICATION SOCIETY CERTIFICATION COMPANY

质量管理体系认证证书
QUALITY MANAGEMENT SYSTEM CERTIFICATE

编号: No. **00511Q20979R2M**

兹证明
西部超导材料科技股份有限公司
(注册地址: 陕西省西安市经济技术开发zone明光路12号 邮编: 710018)

This is to certify that the Quality Management System (QMS) of

WESTERN SUPERCONDUCTING TECHNOLOGIES CO., LTD.

(Registered/Production Add: No.12, MINGGUANG ROAD, ECONOMIC & TECHNOLOGICAL DEVELOPMENT ZONE, XI'AN CITY, SHAANXI PROVINCE, 710018, P.R.CHINA)

建立的质量管理体系符合标准: GB/T 19001-2008 / ISO 9001:2008, has been found to conform to standard GB/T 19001-2008 / ISO 9001:2008.

本证书对下述范围的质量管理体系有效: *超导材料、钛及其加工材料等设计、研发、生产和销售*。

This certificate is valid to the following scope for QMS: *DESIGN, RESEARCH AND DEVELOPMENT, PRODUCTION AND SERVICE OF SUPERCONDUCTING MATERIALS, TITANIUM AND ITS PROCESSING MATERIALS*.

本证书有效期至: **2014年8月11日**。
This certificate is valid until **11 August 2014**.

发证日期: **2012年9月18日**
Reissued on **18 September 2012**
发证日期: **2011年8月12日**
Issued on **12 August 2011**

总经理:
General Manager **Huang Shiyuan**

ISO9001B

格式: M1102R02

BUREAU VERITAS
Certification

Certification
Awarded to
WESTERN SUPERCONDUCTING TECHNOLOGIES CO. LTD.
NO. 12, MINGGUANG ROAD
XI'AN ECONOMIC & TECHNOLOGICAL DEVELOPMENT ZONE
XI'AN, SHANXI, CHINA

Bureau Veritas Certification North America, Inc. certifies that the management system of the above organization has been audited and found to be in accordance with the requirements of the management system standards and scope of supply detailed below

STANDARDS

ISO 9001:2008 AND AS 9100 C
IN ACCORDANCE WITH AS9104/1 Issue 2012-01

Bureau Veritas Certification North America, Inc. is accredited under the I.A.Q.G. 200P Scheme.
Certification Structure: Single Site
SCOPE OF SUPPLY

DESIGN, DEVELOPMENT AND MANUFACTURE OF TITANIUM AND TITANIUM ALLOY BARS, MANUFACTURE OF TITANIUM ALLOY FORGINGS FOR AEROSPACE INDUSTRY.

Original Approval Date: **3 August 2010**
Subject to the continued satisfactory operation of the Organization's Management System, this certificate will remain valid until **1 August 2016**
Further clarifications regarding the scope of this certificate and the applicability of the management system requirements may be obtained by consulting the organization.

Certificate No.: **271802**
Issue Date: **2 August 2013**

Bureau Veritas Certification North America, Inc.
300 DeSoto Drive, Houston, Texas, USA
www.bv.com/cn/na.com/bv/c

AS9001C

格式: M1102R02

中国船级社质量认证公司
CHINA CLASSIFICATION SOCIETY CERTIFICATION COMPANY

环境管理体系认证证书
ENVIRONMENTAL MANAGEMENT SYSTEM CERTIFICATE

编号: No. **00513E21212R0M**

兹证明
西部超导材料科技股份有限公司
(注册地址: 陕西省西安市经济技术开发zone明光路12号 邮编: 710018)

This is to certify that the Environmental Management System (EMS) of

WESTERN SUPERCONDUCTING TECHNOLOGIES CO., LTD.

(Registered/Production Add: No.12, MINGGUANG ROAD, ECONOMIC & TECHNOLOGY DEVELOPMENT ZONE, XI'AN CITY, SHAANXI PROVINCE, 710018, P.R.CHINA)

建立的环境管理体系符合标准: GB/T 24001-2004 / ISO 14001:2004, has been found to conform to standard: GB/T 24001-2004 / ISO 14001:2004.

本证书对下述范围的环境管理体系有效: *超导材料、钛及其加工材料等设计、研发、生产和销售*。

This certificate is valid to the following scope for EMS: *DEVELOPMENT, PRODUCTION AND SERVICE OF SUPERCONDUCTING MATERIALS, TITANIUM AND IT'S PROCESSING MATERIALS*.

本证书有效期至: **2016年9月3日**。
This certificate is valid until **3 September 2016**.

发证日期: **2013年9月4日**
Issued on **4 September 2013**

总经理:
General Manager **Huang Shiyuan**

ISO14001

1.6 Certification



Nadcap Heat treatment and Nondestructive testing certificate



Western Superconducting Technologies Co., Ltd.

Test Report

No. TSNEC1500225001 Date: 06 Mar 2015 Page 1 of 9

WESTERN SUPERCONDUCTING TECHNOLOGIES CO.,LTD
NO.12,MING GUANG ROAD,ECONOMIC & TECHNOLOGICAL DEVELOPMENT
ZONE,XI'AN,SHANXI,CHINA

The following sample(s) was/were submitted and identified on behalf of the clients as : MRINbTi/Cu
MULTI-FILAMENT STRAND

SGS Job No. : TP15-001017 - TJ
Main Substance : Nb,Ti,Cu,Sn,Ag,PET
Date of Sample Received : 04 Mar 2015
Testing Period : 04 Mar 2015 - 06 Mar 2015
Test Requested : Selected test(s) as requested by client.
Test Method : Please refer to next page(s).
Test Results : Please refer to next page(s).

Signed for and on behalf of
SGS-CSTC Standards Technical Services (Tianjin) Co., Ltd.

Rebeca Zhou
Approved Signatory



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Attention: To check the authenticity of testing /inspection report & certificate, please contact us at telephone: (86-755) 8307 1443, or email: CN.Doccheck@sgs.com

SGS Mansion, No.41, The 5th Avenue TEDA, Tianjin, China 300457 t (86-22) 65288000 f (86-22) 25295252 www.sgs.com.cn
中国·天津经济技术开发区第五大街41号SGS大厦 邮编: 300457 t (86-22) 65288000 f (86-22) 25295252 e sgs.china@sgs.com

ROHS level: Level 4

Cadmium, Lead, Mercury, Hexavalent Chromium, PBBs(Polybrominated biphenyls) and PBDEs(PBDEs) (Polybrominated biphenyl ethers)

- Test Method : (1) With reference to IEC 62321-5:2013, determination of Cadmium by ICP-OES.
(2) With reference to IEC 62321-5:2013, determination of Lead by ICP-OES.
(3) With reference to IEC 62321-4:2013, determination of Mercury by ICP-OES.
(4) With reference to IEC 62321:2008, determination of Hexavalent Chromium by spot test / Colorimetric Method using UV-Vis.
(5) With reference to IEC 62321:2008, determination of PBBs and PBDEs by GC-MS.

Test Item(s)	Unit	MDL	001
Cadmium (Cd)	mg/kg	2	ND
Lead (Pb)	mg/kg	2	ND
Mercury (Hg)	mg/kg	2	ND
Hexavalent Chromium (Cr(VI))	-	◇	Negative
Sum of PBBs	mg/kg	-	ND
Monobromobiphenyl	mg/kg	5	ND
Dibromobiphenyl	mg/kg	5	ND
Tribromobiphenyl	mg/kg	5	ND
Tetrabromobiphenyl	mg/kg	5	ND
Pentabromobiphenyl	mg/kg	5	ND
Hexabromobiphenyl	mg/kg	5	ND
Heptabromobiphenyl	mg/kg	5	ND
Octabromobiphenyl	mg/kg	5	ND
Nonabromobiphenyl	mg/kg	5	ND
Decabromobiphenyl	mg/kg	5	ND
Sum of PBDEs	mg/kg	-	ND
Monobromodiphenyl ether	mg/kg	5	ND



SGS-CSTC Standards Technical Services (Tianjin) Co., Ltd.
Chemical Laboratory (Tianjin) Co., Ltd.

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Attention: To check the authenticity of testing /inspection report & certificate, please contact us at telephone: (86-755) 8307 1443, or email: CN.Doccheck@sgs.com

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中国·天津经济技术开发区第五大街41号SGS大厦 邮编: 300457 t (86-22) 65288000 f (86-22) 25295252 e sgs.china@sgs.com

Member of the SGS Group (SGS SA)

outline

1

Brief Introduction of WST

2

WST Products for ITER

3

WST Products for MRI/NMR

4

WST Products for HEP

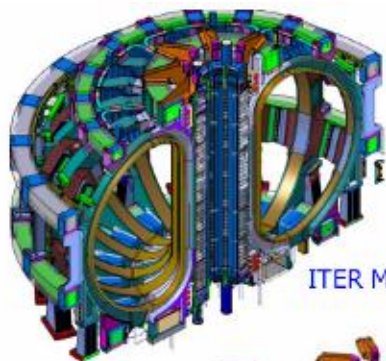
5

Summary



International Thermonuclear Experimental Reactor (ITER)

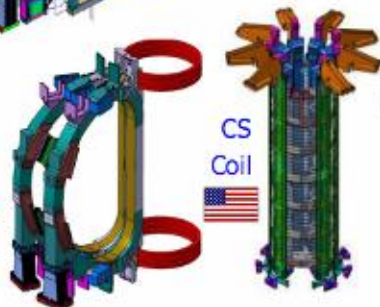
- The ITER magnet system is made up of
 - 18 Toroidal Field (TF) Coils,
 - a 6-module Central Solenoid (CS),
 - 6 Poloidal Field (PF) Coils,
 - 9 pairs of Correction Coils (CC's).



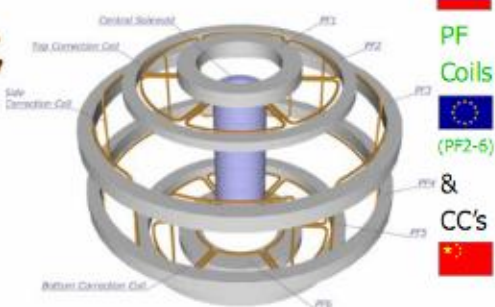
ITER Magnet System



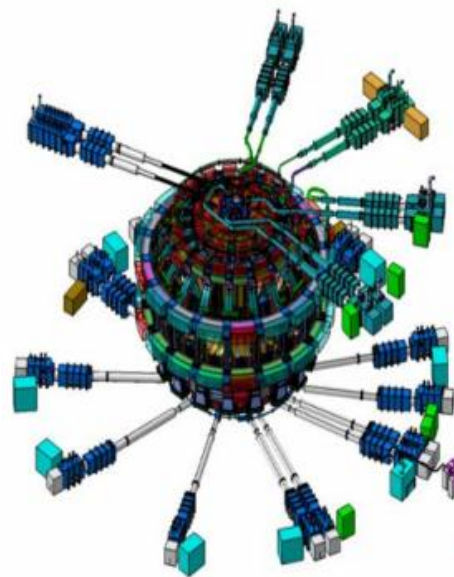
Pair of TF Coils



CS Coil



- (PF1)
- PF Coils
- (PF2-6)
- & CC's



ITER Feeder System

China (WST):

180 t NbTi strand

30 t Nb3Sn strand

Coils	Superconducting wire	Weight (t)	Proportion (%)					
			CN	EU	JA	KO	RF	US
TF	Nb ₃ Sn	420	7.5	20.2	25	20	19.3	7.8
CS	Nb ₃ Sn	122			100			
PF	NbTi	224	65				35	
CC/Feeder	NbTi	21	100					

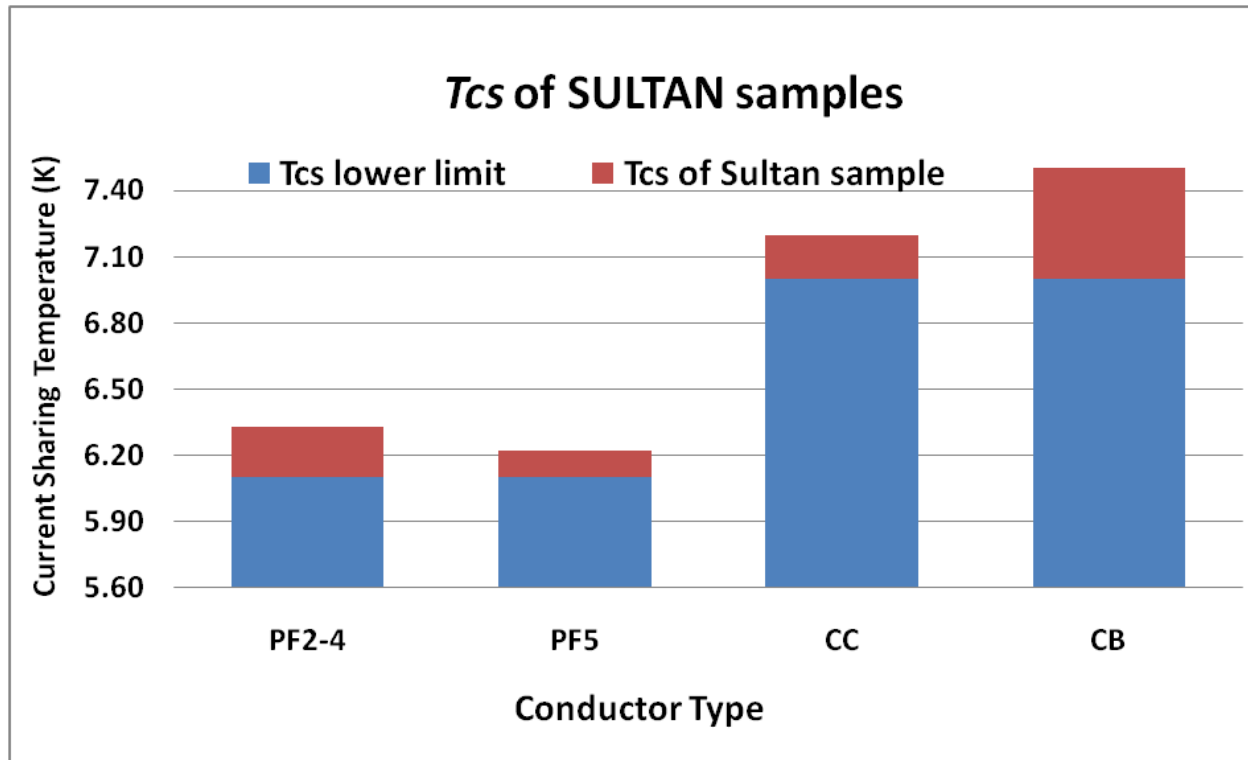
Performance of WST NbTi Strand

Items	ITER specifications	WST performance
Piece length (m)	>1000	Max.=90,000
Diameter (mm)	0.730 ± 0.005	0.727-0.732
Twist pitch (mm)	15 ± 2	13.2-16.8
Ni thickness (μm)	$2.0+0/-1$	1.3-1.6
Cu/non-Cu	2.35 ± 0.1	2.28-2.34
Filament diameter (μm)	≤ 8	7.8-8.0
RRR (273/10 K)	> 100	110-160
I_c (A) @4.2 K, 5T	≥ 339	360-390
Q_h (mJ/cm^3) @4.2 K, $\pm 1.5\text{T}$	<45	35-45

Performance of WST NbTi strand can completely meet ITER specifications.

Sultan sample results

- WST produces NbTi strand for 4 types of conductor: PF2-4, PF5, CC and Feeder.
- All 4 types of Sultan samples have passed the qualification test.
- Up to now, 10 Sultan samples made by WST NbTi strand have been qualified.

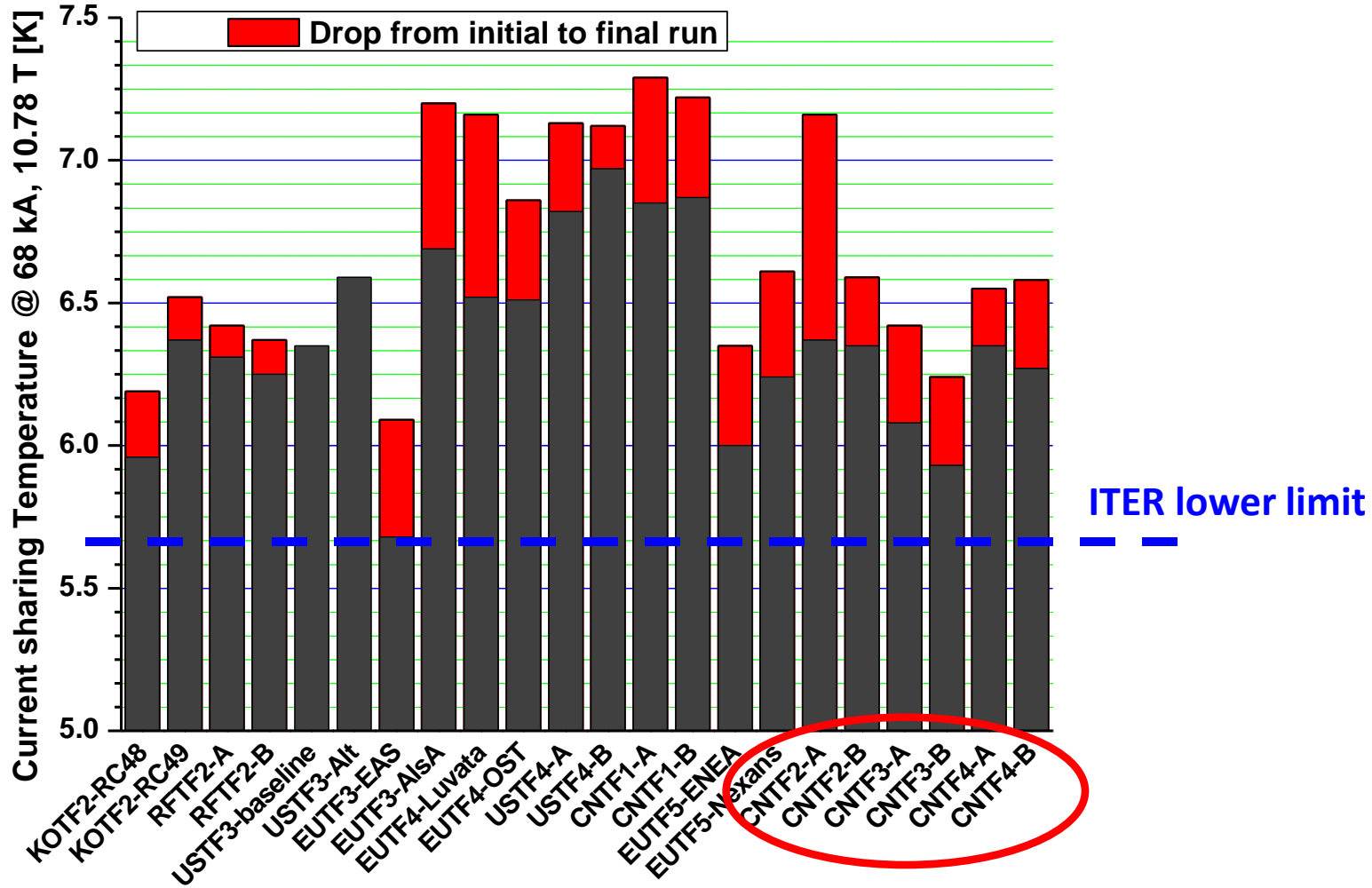


Performance of IT and Bronze Nb₃Sn Strand

Items	ITER specifications	WST IT Nb ₃ Sn strand	WST bronze Nb ₃ Sn strand
Piece length (m)	>1000	Max.=10,000	Max.=7,000
Diameter (mm)	0.820 ± 0.005	0.819-0.823	0.818-0.823
Twist pitch (mm)	15 ± 2	15.60-16.20	15.80-16.30
Cr thickness (μm)	2.0+0/-1	1.34-1.96	1.24-1.89
Cu/non-Cu	1 ± 0.1	0.91-1.05	0.91-1.02
RRR (273/20 K)	> 100	108-238	132-173
I _c (A) @4.2 K, 12 T	> 190	230-270	220-250
n value @4.2 K, 12 T	> 20	26-36	30-40
Q _h (mJ/cm ³) @4.2 K, ± 3 T	< 600	370-560	380-440

Performance of WST IT and Bronze Nb₃Sn strand can completely meet ITER specifications.

Comparison of all TF SULTAN Samples



Three TF SULTAN samples made of WST IT Nb₃Sn strands show the same good performance as other samples.

outline

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WST Products for ITER

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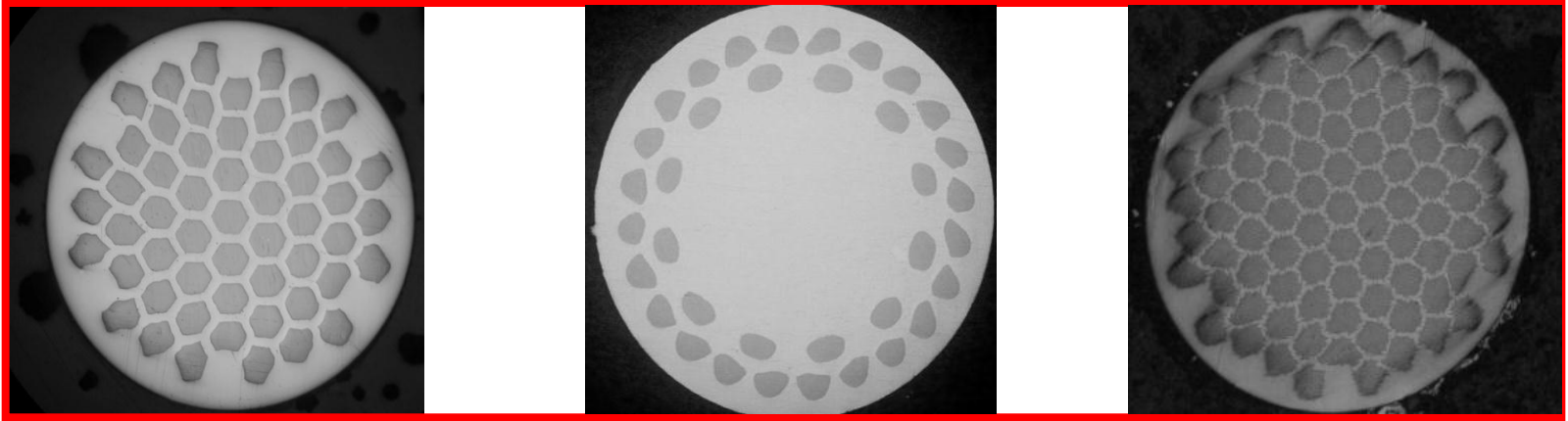
WST Products for MRI/NMR

4

WST Products for HEP

5

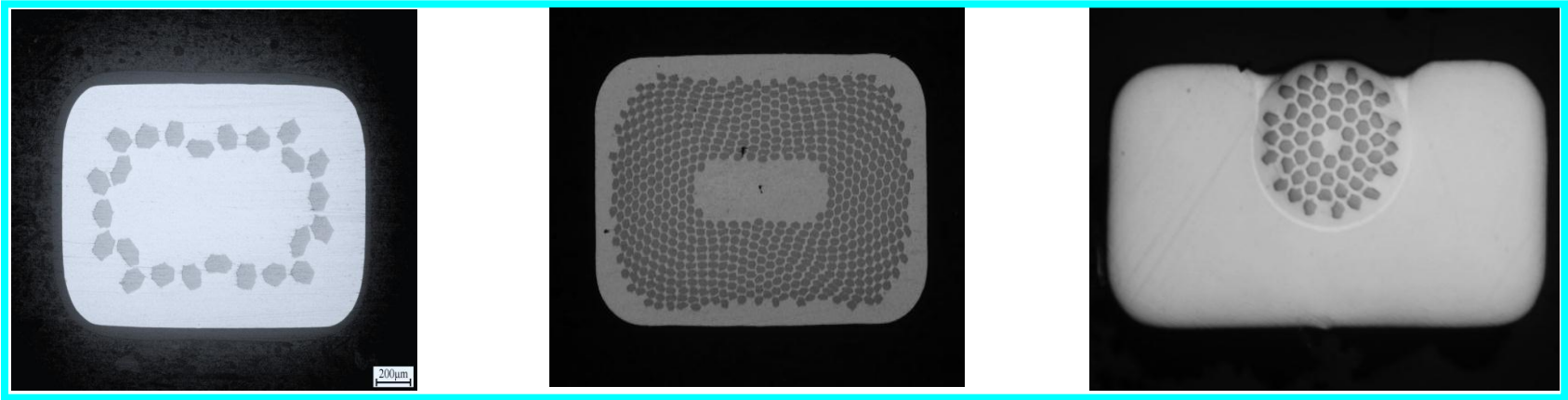
Summary



Cu/Sc=1.3, 55, $\Phi 0.97$ mm

Cu/Sc=4, 36, $\Phi 1.6$ mm

Cu/Sc=1.8, 7225, $\Phi 0.7$ mm



Cu/Sc=7, 24, 1.8×1.2 mm

Cu/Sc=1.3, 630, 1.28×0.83 mm

Cu/Sc=11, 54, 1.94×1.12 mm

Typical parameters and properties of NbTi wire (monolith)

Item	NO.1(M)	NO.2(M)	NO.3(M)	NO.4(M)	NO.5(M)	NO.6(M)
Dimension of wire (mm)	Φ0.73	1.28*0.83	1.8*1.2	1.0*0.6	Φ1.067	1.28*0.83
Number of the filaments	3366	630	36	630	54	36
Twist pitch (mm)	15	15	50	15	75	50
Cu/Sc	1.60	1.3	4	1.3	2.5	4
RRR(273/10K)	>100	>100	>120	>100	>120	>120
I_c (A)@4.2K	>100 (9T)	>630 (7T)	>525 (7T)	>750 (5T)	>550 (6T)	>450 (5T)
n value	>30	>30	>25	>25	>30	>25

- ※ WST can design and produce according to customers' request.
- ※ Till now, WST has delivered about 100 tons wire for MRI.

outline

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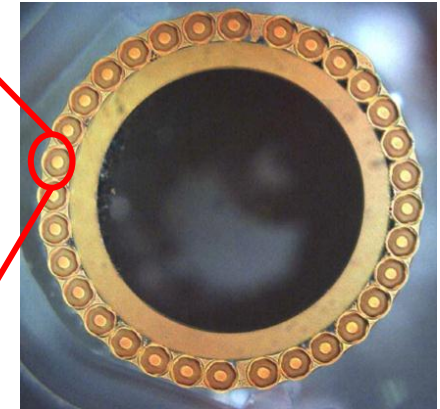
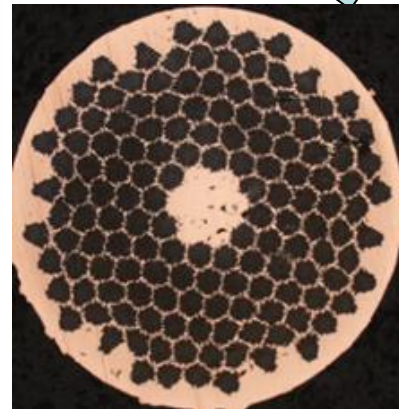
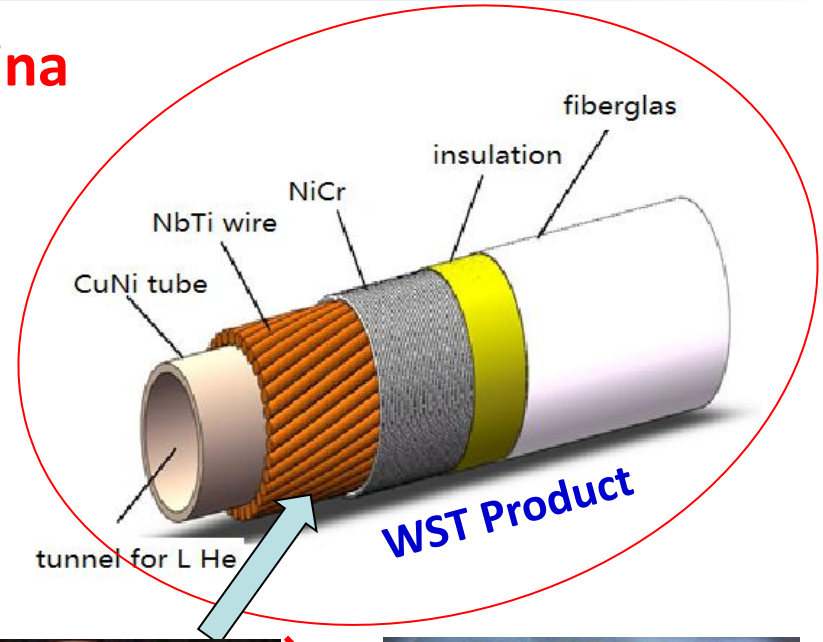
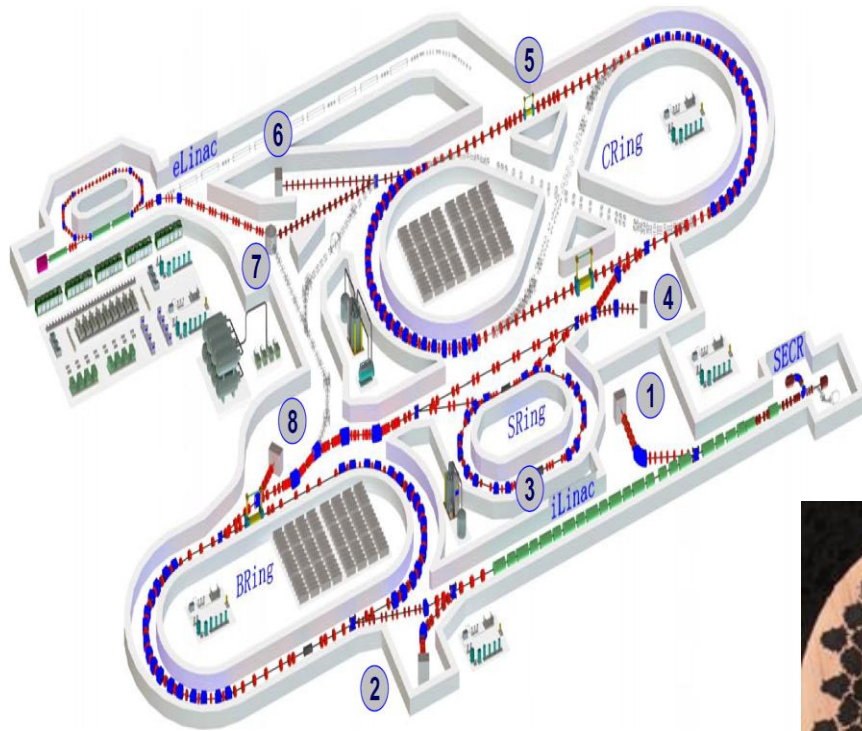
WST Products for HEP

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Summary



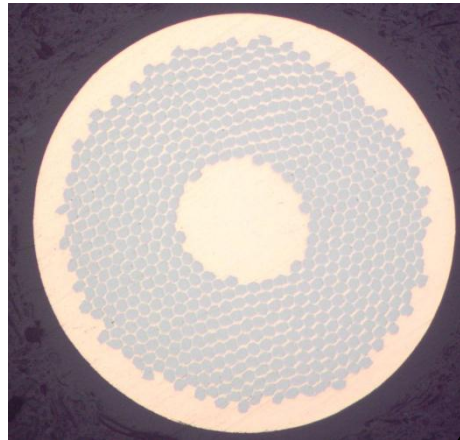
Heavy Ion Accelerator Facility in China



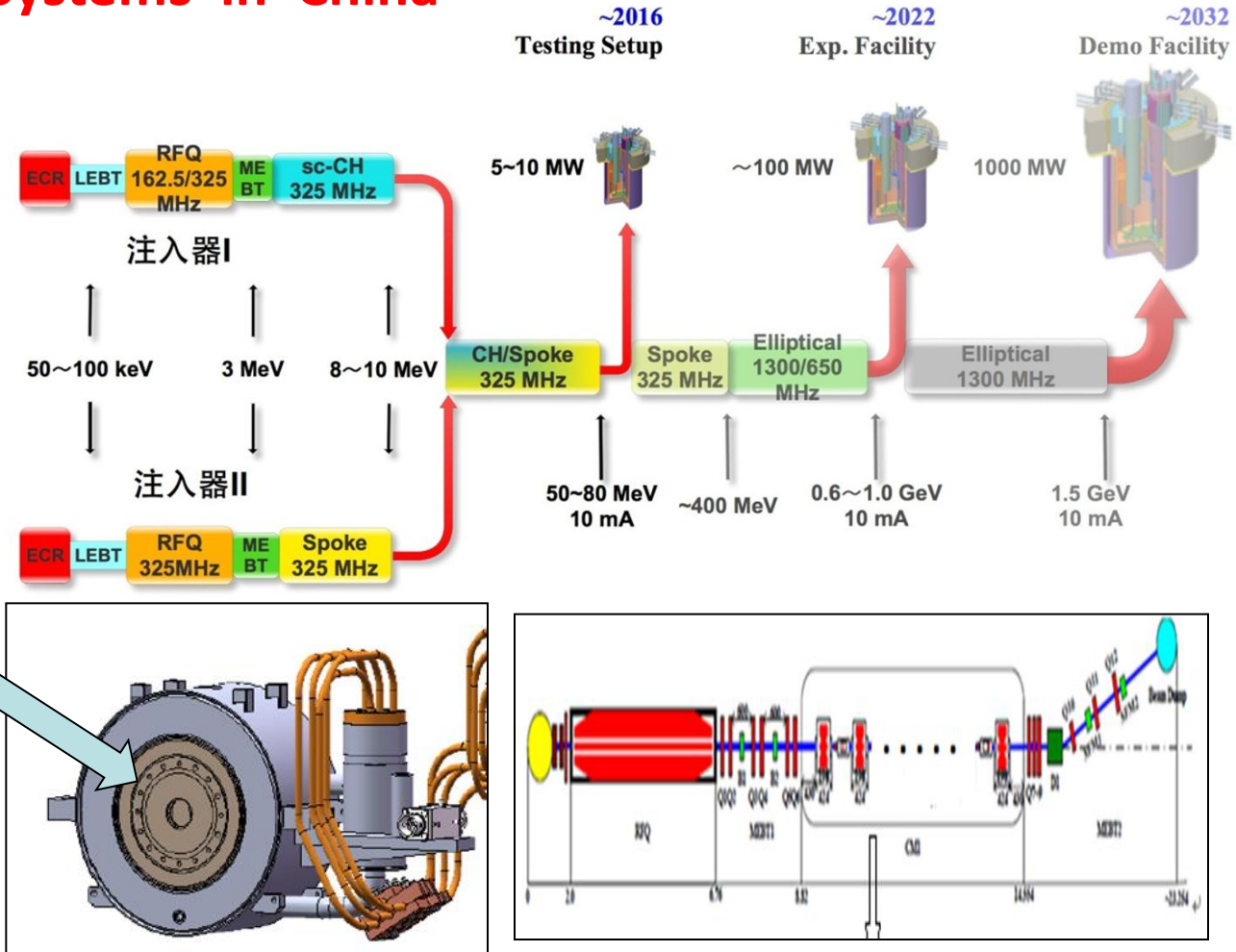
Df :3~5 μ m
Jc:>2500A/mm²(4.2K,5T)
Stabiliazer: CuNi

WST are supplying the fine filament NbTi/CuNi superconducting conductor for HIAF project.

Accelerator driven Systems in China



No. of filament :630
 $J_c \rightarrow 2900 A/mm^2 (4.2K, 5T)$
 Insulation: Formvar



WST are supplying the high preformance NbTi superconducting wire for ADS project.

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Summary

Summary

- ◆ WST have capability of advanced Ti alloy and superconductor production lines: 6000 ton ingots of Ti alloy, 3000 ton rods of Ti alloy and 900 ton superconductor per year.
- ◆ Though the mass production of ITER wire, WST has built our technique and quality system for superconducting wire.
- ◆ WST are involved in ITER project as a unique supplier of NbTi and Nb₃Sn superconducting wires in china, and 120 tons high performance wires have been delivered until 2014.
- ◆ We have rich experience of manufacturing the high Cu:Sc NbTi wires for MRI, and supply the product with stable quality and effective cost solutions.
- ◆ WST also put forth effort to the customized superconductor for High Energy Physics, NMR, and High Magnetic Field applications.



Western Superconducting Technologies Co., Ltd.

Thanks for your attention!