IEA-HTS-Exco Meeting at NEDO, Kawasaki, Japan
July 3 to 5, 2017

HTS Activity in China

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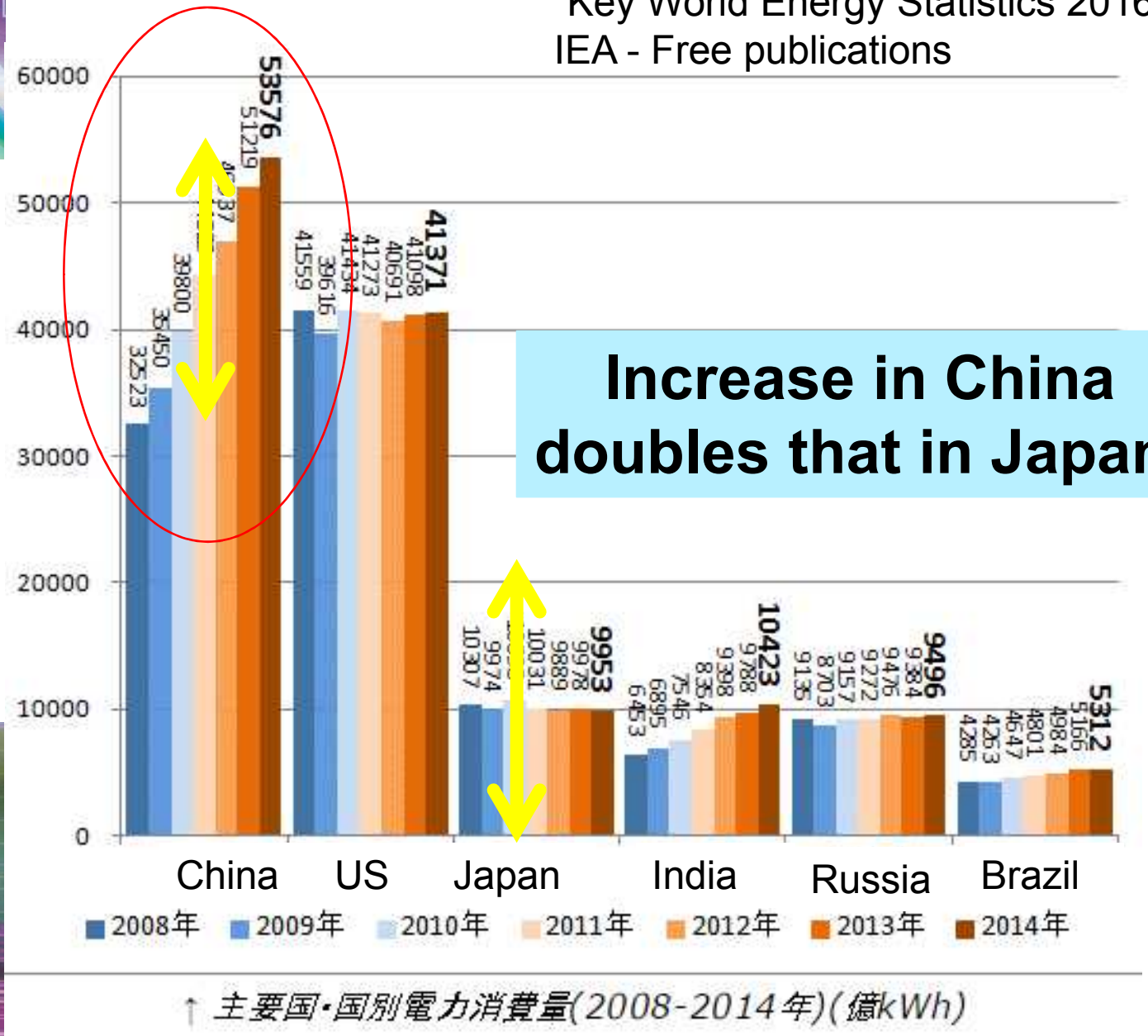
(IEA-HTS OA)
(SSTC: Shanghai Superconductor Technology Co. Ltd.,
Shanghai Jiao Tong University)

July 4, 2017

Electric Power Consumption for the past decade

"Key World Energy Statistics 2016" in IEA - Free publications



↑ 主要国・国別電力消費量(2008-2014年)(億kWh)

Active Area in China for HTS

Research institute in China studying REBCO

Research Teams for Materials (11 Teams)

Research Institute or Company	Research Activities
NIN/Western Superconductor	NbTi, Nb3Sn/Al, BSCCO-2212, 2223, MgB2, YBCO Substrates
IEE-CAS	
SHJT Univ/Shangh	
Shanghai Univ/Sh	
Suzhou-NANO	
BUT	
Innova Supercondu	
Tianjing Hytech	
GRINM	
Peking Univ	
STUE	

2G HTS Wire Venture Company in Shanghai Area

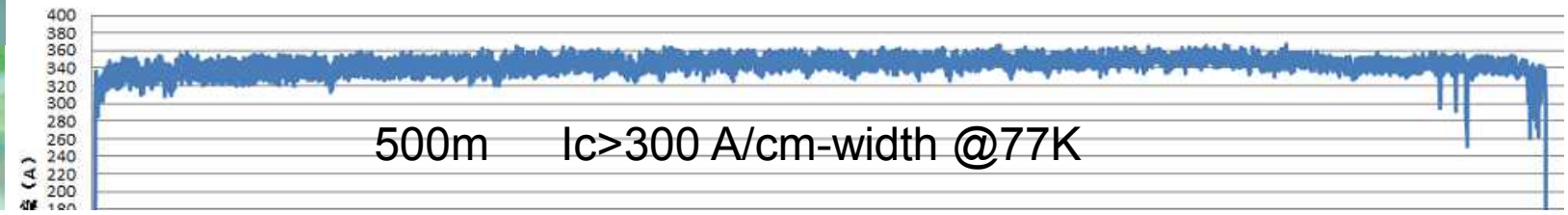
Group	Buffer		HTS		
Company/ University	IBAD	NiW	PLD	MOD	MOCVD
Shanghai Supercond. Technol. Co., Ltd (SSTC)/ Shanghai Jiao Tong Univ.	R2R		R2R		
Shanghai Creative Supercond. Technol. Co., Ltd (SCSTC)/ Shanghai Univ.	R2R	R2R		R2R	
Suzhou Advanced Materials (SAMRI)	R2R				R2R

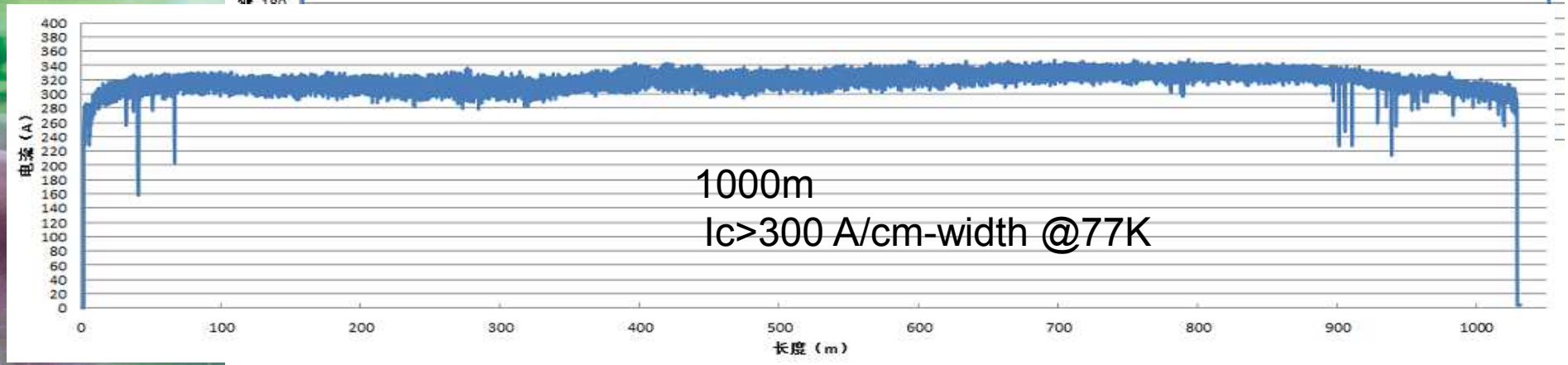
Prof. Cai of Shanghai Univ. ,Dr. Xiao of CAS, Beijing

SSTC, Shanghai Superconductor Tech. Co., Ltd, & SJTU

PLD-YBCO line of SSTC

SSTC in Shanghai.

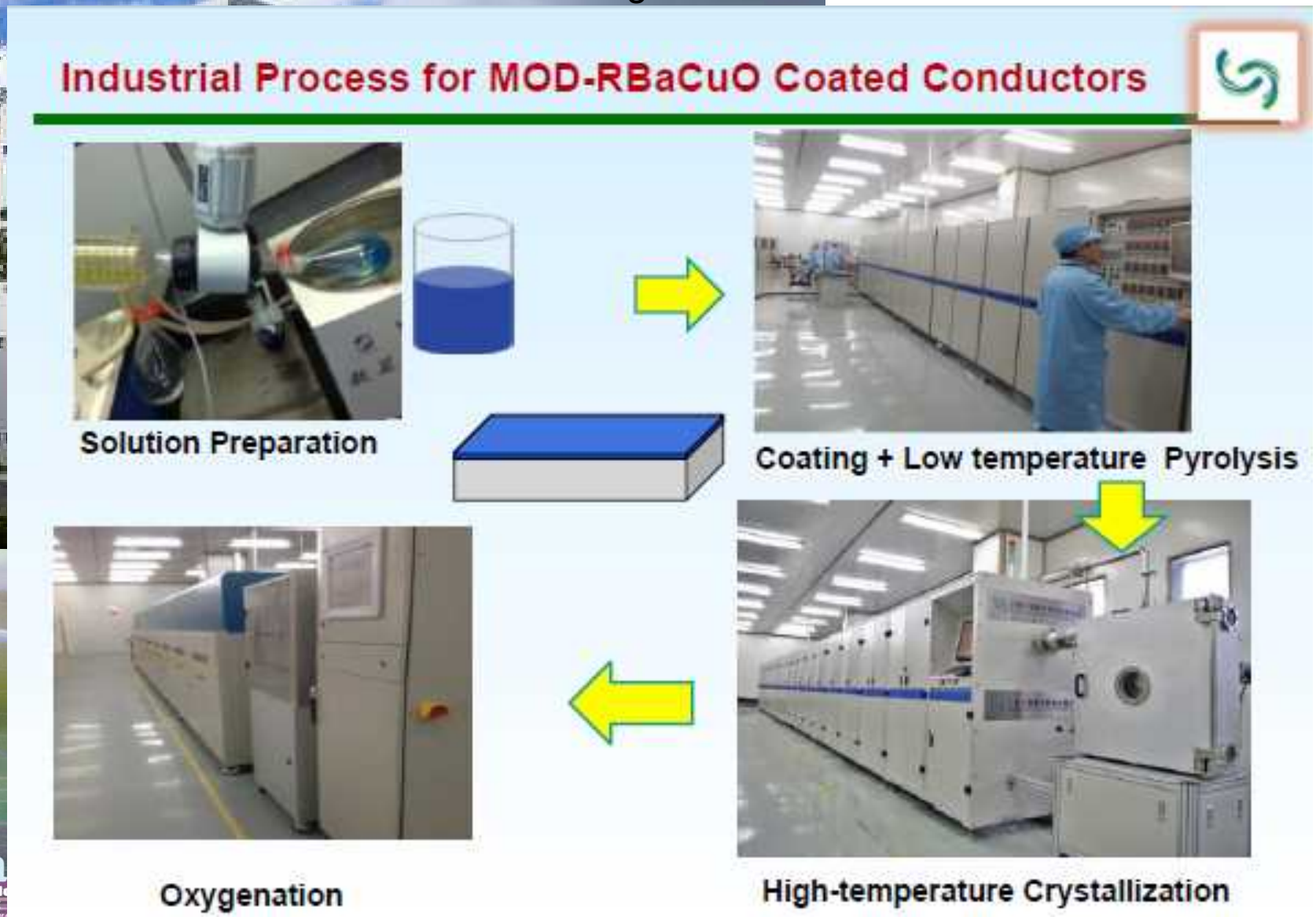




1000m long PLD -YBCO on IBAD with sharp texture

SCSTC, Shanghai Creative Superconductor Tech. Co., Ltd, & Shanghai Univ.

SCSTC in Shanghai.

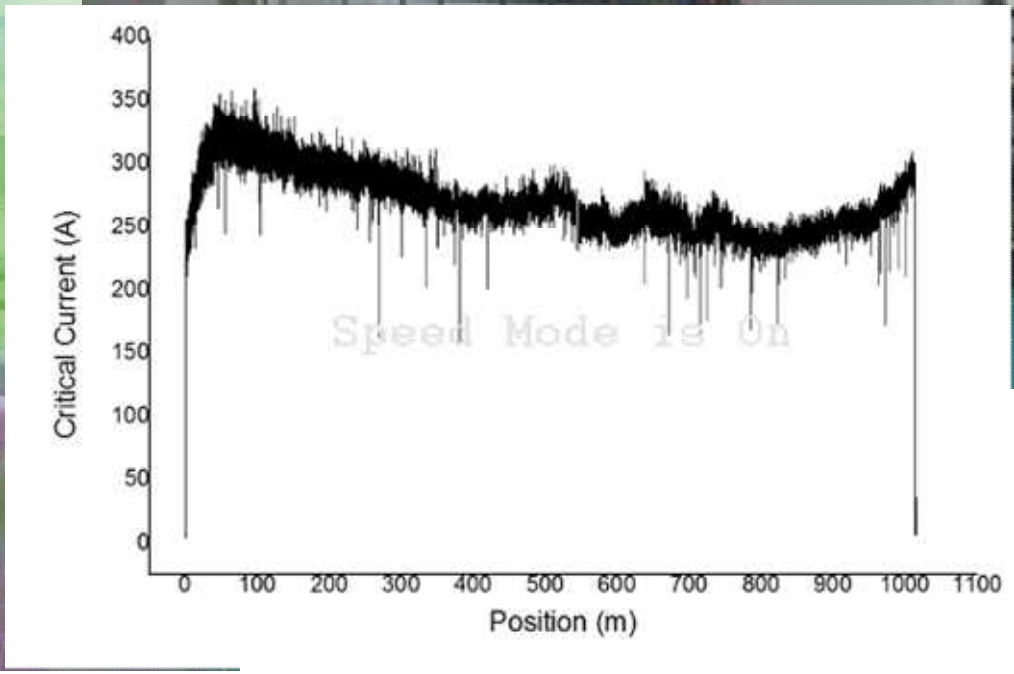


Prof. Cai of Shanghai university

SAMRI, Suzhou Advanced Materials Research Institute

MOCVD-YBCO layer deposition

Capability > 1000m Width of tape 12mm
Speed：50 -100 m/h Thickness of YBCO 1-3 μm



Profs. Zhang of NIN, Xian and Cai of Shanghai univ.

Ic=280 A/cm-width @77K

MOCVD system can deposit 1-3 μ m YBCO layer with sharp texture on km-level IBAD-MgO layer.

For Users: Most Recent Data of Commercial REBCO Wire (by KEK, 2017)

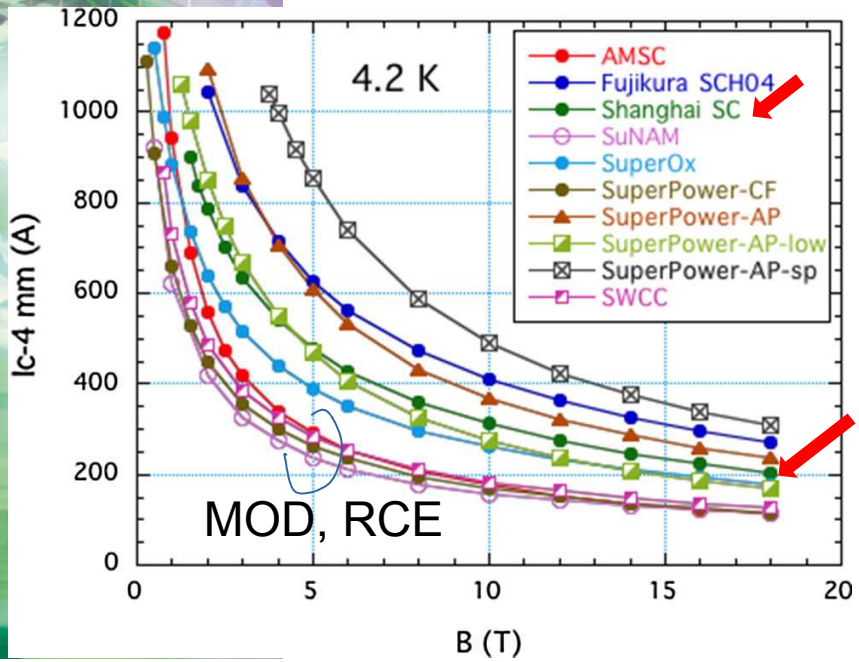


Fig. 5. Transport Ic for 4-mm-wide conductors versus B for commercial conductors in perpendicular fields at 4.2 K. The estimated errors of the Ic values are less than 2–3%.

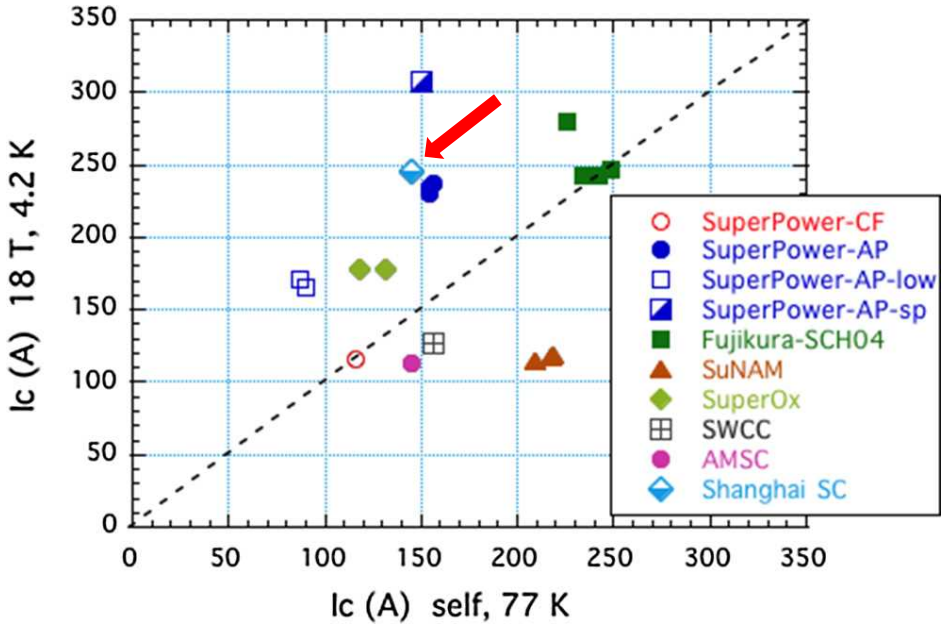
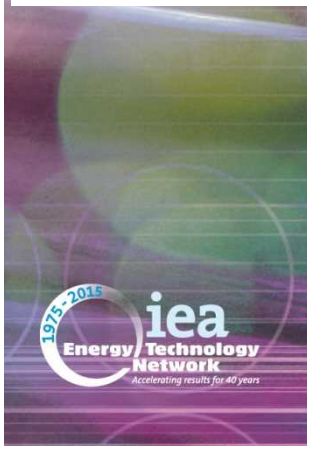


Fig. 6. Ic values of the REBCO conductors measured at 4.2 K and 18 T versus Ic of the same conductor measured at 77 K and under the self-field condition.

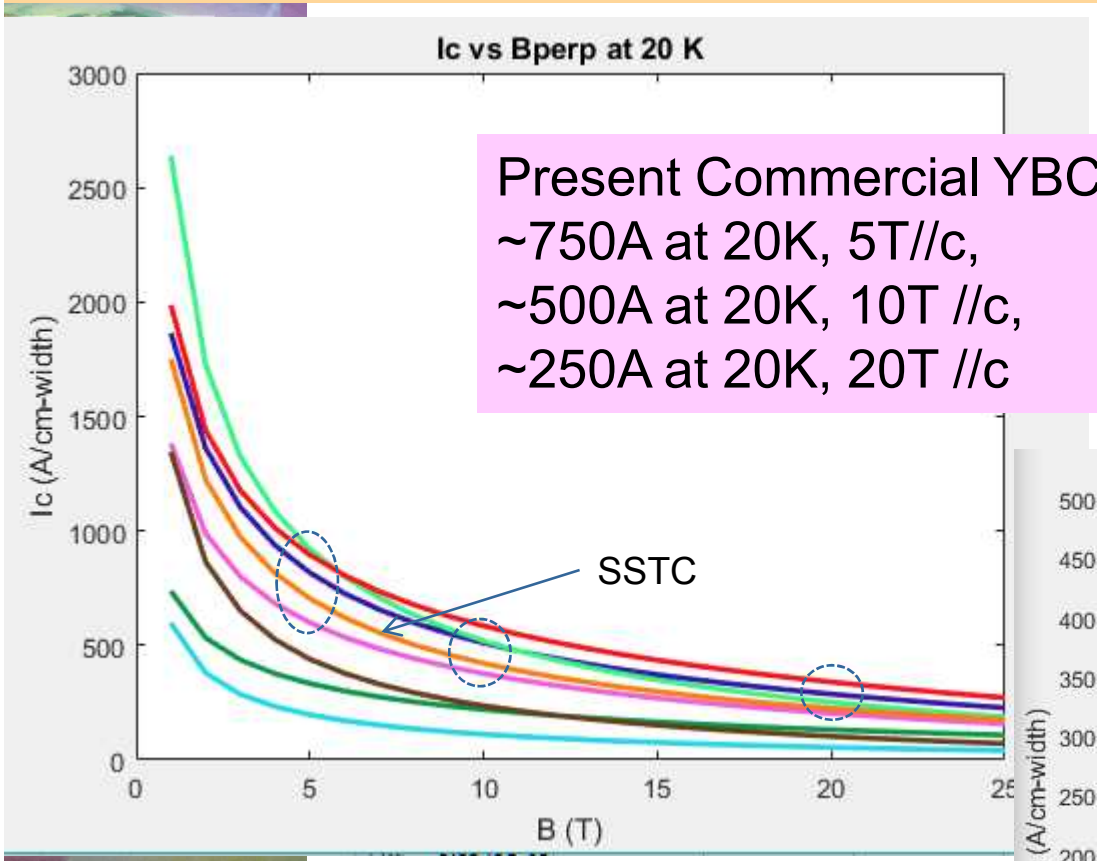


PLD (Fujikukra, SSTC, SuperOx) and MOCVD with pin are good.

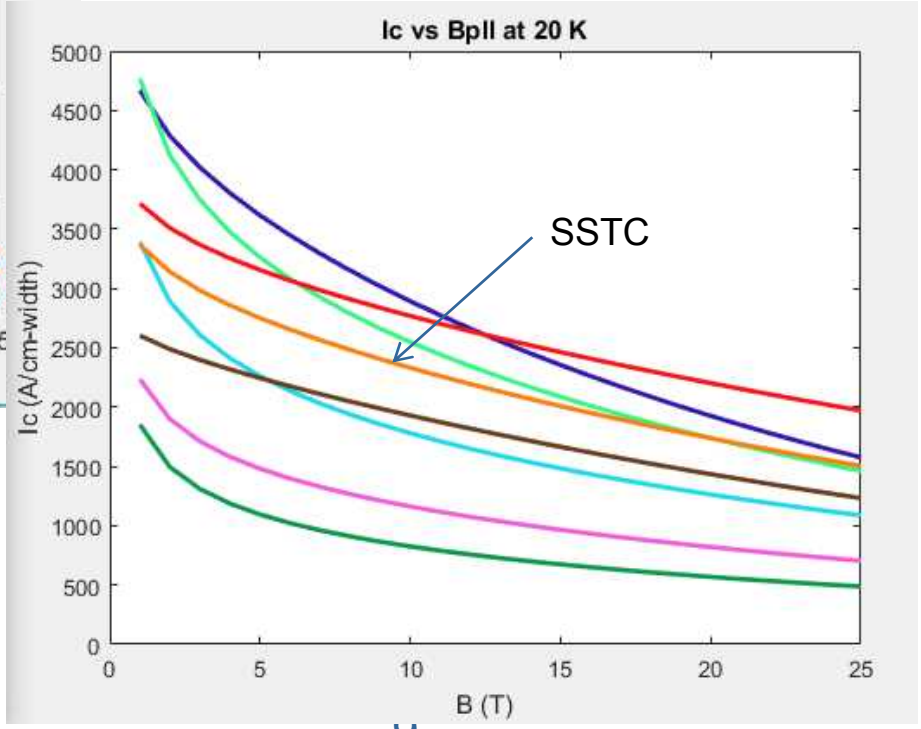
MOD（AMSC）, RCE（SUNAM） group is a little bit worse.

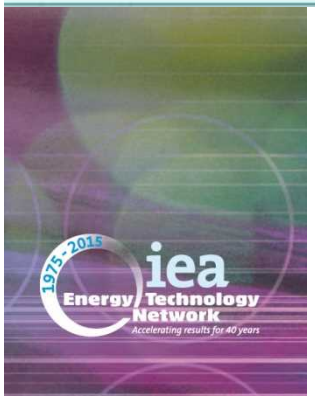
Critical current measurement of commercial REBCO conductors at 4.2 K
K. Tsuchiya et al.,
High Energy Accelerator Research Organization (KEK), Tsukuba 305-0801, Japan.
Cryogenics 85 (2017) 1–7

Ic at 20K of commercial REBCO wires (by RRI, Robinson Research Institute, 2016)



Present Commercial YBCO Wire Ability
~750A at 20K, 5T//c,
~500A at 20K, 10T //c,
~250A at 20K, 20T //c





Research Teams for Large-Scale Applications (15 Teams)

Research Institute or Company	Research Activities
IEE-CAS	FCL, Cable, SMES, Transformer, Electric Machine, NMR, MRI, High Field Magnet, accelerator magnet, Fusion Magnet and other applications
HUST	FCL, SMES, Electric Machine
WHI-712	Electric Machine
Tsinghua Univ	MRI, Cable, FCL, SMES
Tianjing Univ/Innopower	Cable, FCL
CEPRI	Cable, SMES, FCL
NCUEP	Cable
SWJTU	Maglev
SICT	Cable
Western Superconductor	MRI, High Field Magnet
Hefei-CAS	Fusion Magnet, High Field Magnet
IHEP-CAS	Accelerator Magnet, MRI, ADS magnet, Magnetic separation
IMP-CAS	Accelerator Magnet, ADS magnet
IAEC	cyclotron accelerator magnet
TIPC-CAS	Fusion Magnet, high field Magnet
SIAP-CAS	Magnet for FEL, Cavity

Cable, FCL and MRI are active.

2G HTS Cable System

SECRI 上海电缆研究所 SHANGHAI ELECTRIC CABLE RESEARCH INSTITUTE

- **Electrical Characteristics**
  - Design 35kV/2000A ~ 120MVA
- **Physical Characteristics**
  - Materials ~ 2G HTS Wire
  - Length ~ 50m
  - HTS Conductor Length ~13km
  - Cold Dielectric Design
- **Hardware Deliverables**
  - Three ~50 m Long Phase Conductors
  - Six 35kV Outdoor Terminations

2G HTS Cable Demo at Baosteel, since Dec 2013

Prof. Cai of Shanghai university

Discussion for HTS Cable Project in Shanghai, 2017 April 20

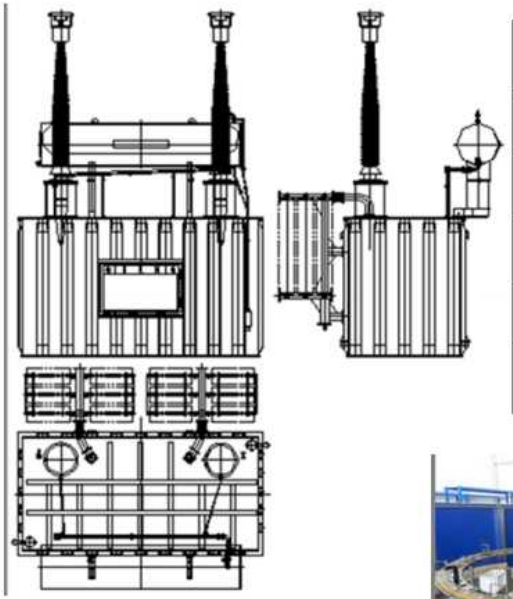
Members: Shanghai government, HTS wire companies (SSTC, SCSTC), Shanghai Electric Power Research Institute, Electric Power Companies

Source: http://www.sheitc.gov.cn/zxxx/673714.htm; SHEITC, Shanghai Economy and Information Technology Committee

FCL Activities in China

Especially, High Voltage FCL (220, 500kV)

South Power Grid: 500kV AC-SFCL (Saturated Type)



Weight of core and windings	155t
Weight of oil	96t
Transport weight	200t
Total weight	320t
Outline:L×W×H	9m × 7.5m × 11.5m
Transport dimension:L×W×H	8.8m×4.5m×4.8m

Innopower: 220kV AC-SFCL (Saturated Type)

In 2012, the 220kV/300MVA SFCL was manufactured and installed at Shigezhuang substation of Tianjin, in grid operation.

Hybrid magnet test finished, BSCCO from Sumitomo, YBCO from SSTC

Source: Report on superconducting materials『超電導材料調査報告』 --
新材料在线 http://www.xincailiao.com/news/news_detail.aspx?id=9613

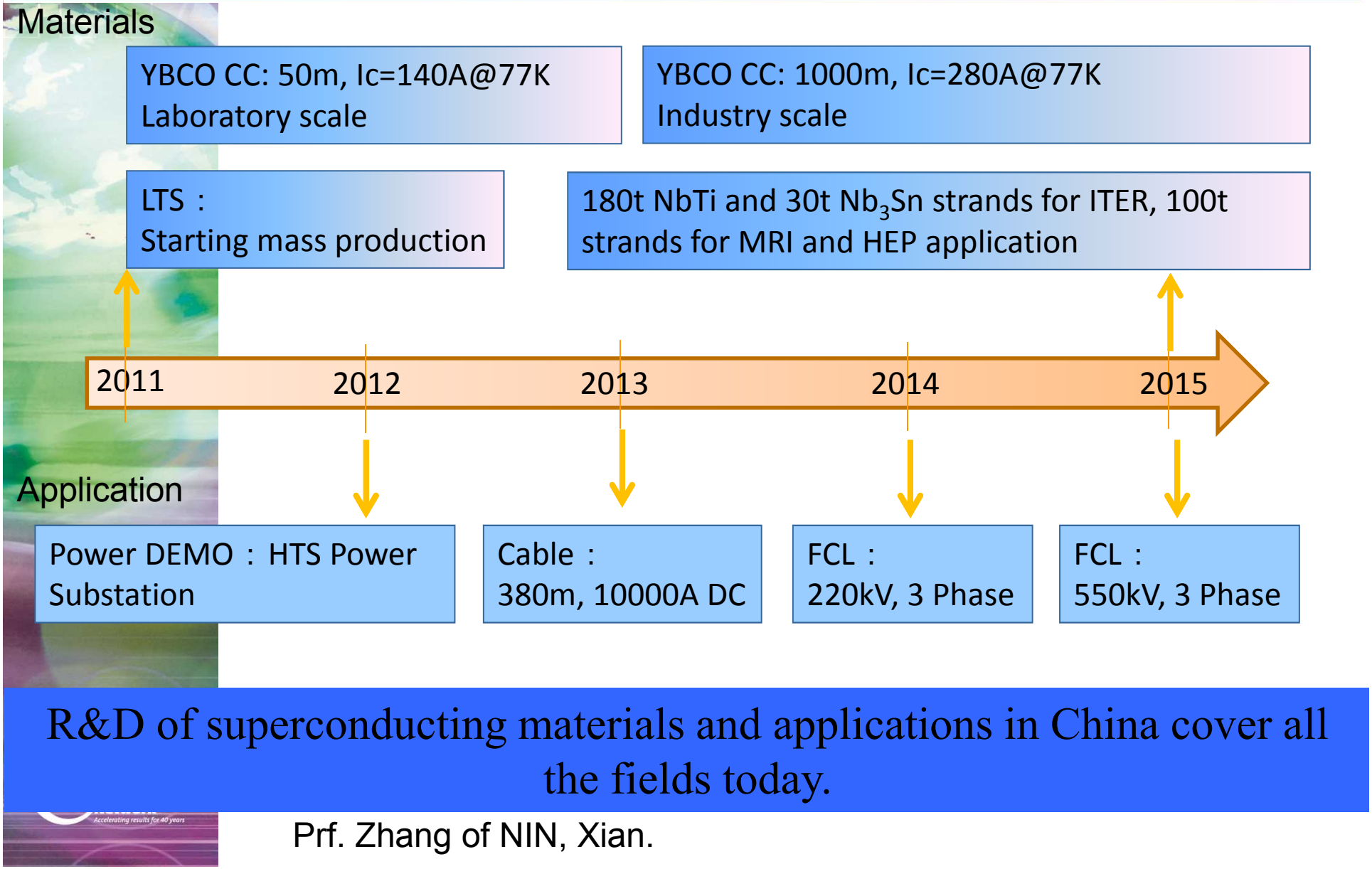
Domestic Market of SFCL 130—150 B RMB~ 22 B US$

No. of substations in China is around 3000. More 2500 ss in 10 years in the plan. Assumptions; 50% SFCL installed, 70% in new ss.
Unit price of 220kV SFCL 3000- 3500x10k RMB~ 5 M US$.

	No of 220KV Substation	Percentage of SFCL	No. of SFCL	220KV Market Size（B RMB）
State Grid Present	2287	50%	1144	34-40
China Southern Power Grid Company Limited Present	527	50%	263	7-9
State Grind in 10 years	2000	70%	1400	42-49
Southern Grid in 10 years	500	70%	350	10-12
SUM Market size of 220kV SFCL	5314	59.4%	3157	94-110
Market size of whole SFCL				135-157

= ~22 B US$

Progress of SC and its application in China



R&D of superconducting materials and applications in China cover all the fields today.

Prf. Zhang of NIN, Xian.

Summary of HTS Activity in China

- Now HTS R&D and commercialization are very active and REBCO wire is the core technology.
- Especially, in Shanghai area, 3 venture REBCO companies are strongly developing the wire and HTS technology .
- FCL and cable applications are most active.
- Further investment is expected due to the large electricity demand in China.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