

# Summary of Session 1: Status of Coated Conductor Development World-Wide

by

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# ACKNOWLEDGMENTS

- **Thanks to:**
  - **Dean Peterson (LANL)**
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  - **Phil Pellegrino (SuperPower)**
  - **Marty Rupich (AMSC)**
  - **Alexander Molodyk (MetOx)**

# CC R&D in China, Europe, and Korea

- **China: Current Research Focus**
  - High Potential for Rapid Progress
- **Europe: Decreased Gov't Support**
  - Excellent European Cooperation
  - CC Companies-Possible US Competition:
    - ZFW (IBAD YSZ/PLD: 190A/10 m)
    - Trithor (RABiTS/CSD Goal 250 m@2007)
    - Theva (ISD/e-beam:486A-227A/1 m)
    - Edison(RABiTS/TCE:120A/2 m),
- **Korea: Substantial Broad Program**
  - RABiTS & IBAD MgO Substrates
  - Several HTS Deposition Approaches
    - MOD, MOCVD, PLD, sputtering, TCE

SmBCO

CeO2

YSZ

CeO2

Ni

# 7m SmBCO-e beam/RABiTS w/km possible

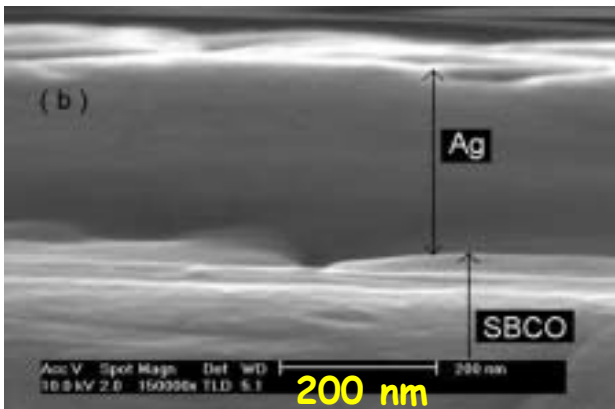
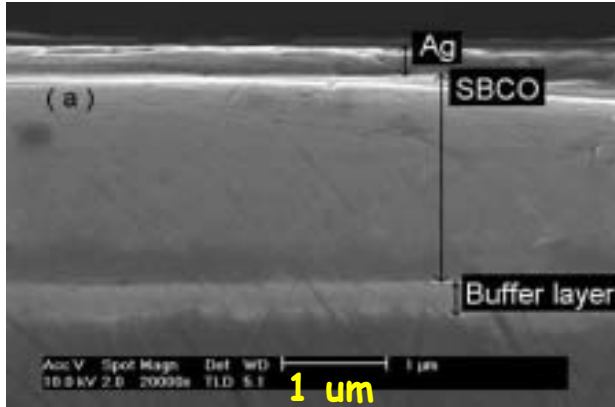
7.5m long, 9mm wide, 2um thick  
Single batch - 7 hours

$T_c \sim 92K$

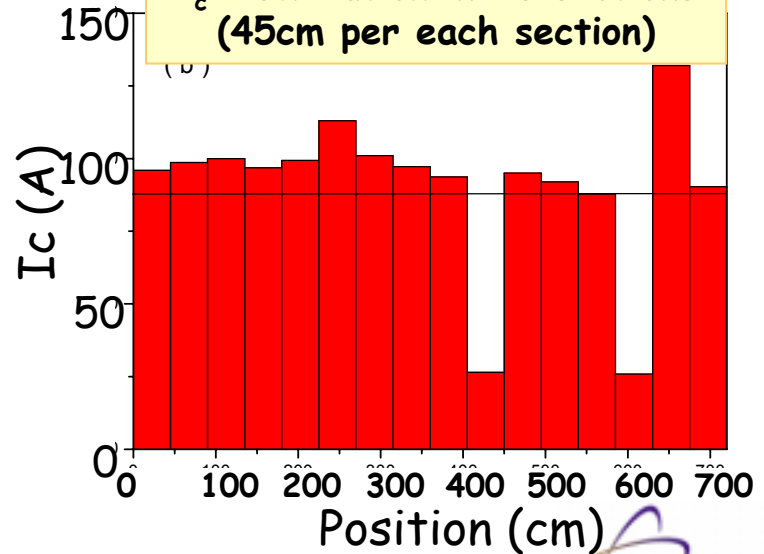
2 bad  $I_c$  spots

4m piece  $I_c(77K, e2e) > 97A$

$I_c(77K)$  mostly 90-100A/cm,  
up to 130A/cm



$I_c$  distribution in 16 sections  
(45cm per each section)



# Status in the USA- AMSC

## Advocated for RABiTS templates and MOD

- Showed for first time pilot scale reaction furnace, reactive sputtering system (spools handle 1-km, up to 10-cm wide tape); roll-slitting line
- Pilot rolling facility due spring 2005
- 2G ~ 1G performance (400-A/cm) in short samples (nanodots); Je for 2G>1G@27K
- >100-A, 3-T perp., 65K approaching military specifications
- Suggested 2G wire performance targets
  - Cables:  $I_c=300A$  (77K)
  - Motors and Generators:  $I_c>450A$  (30K, 1-3T perp.)
  - Military:  $I_c=100A$  (65K, up to 3-T perp.)

# Status in the USA-SuperPower

**Presented rationale for IBAD templates and MOCVD; also helical tape handling and “surround stabilizer”**

- Pilot plant IBAD, MOCVD systems were shown
- New result: 104-A, 97-m (IBAD YSZ, MOCVD)=10,050 A-m
- Short samples by MOCVD yielding  $>400$  A/cm (parity with world’s best BSCCO)
- 8-m IBAD-YSZ now yielding  $>200$  A/cm
- 200 A/cm over 1 m demonstrated with IBAD MgO-MOCVD

# Status in the USA- MetOx

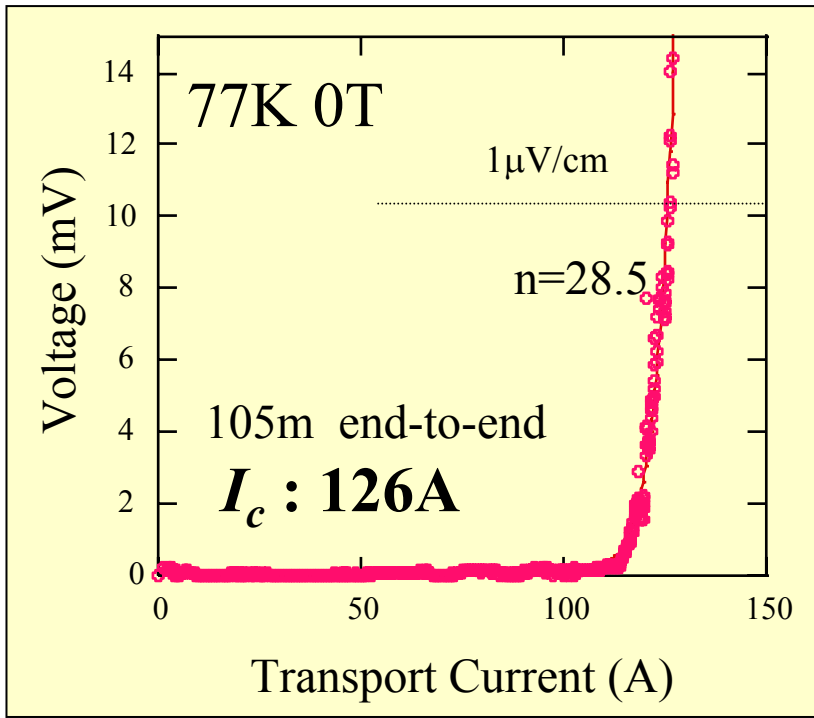
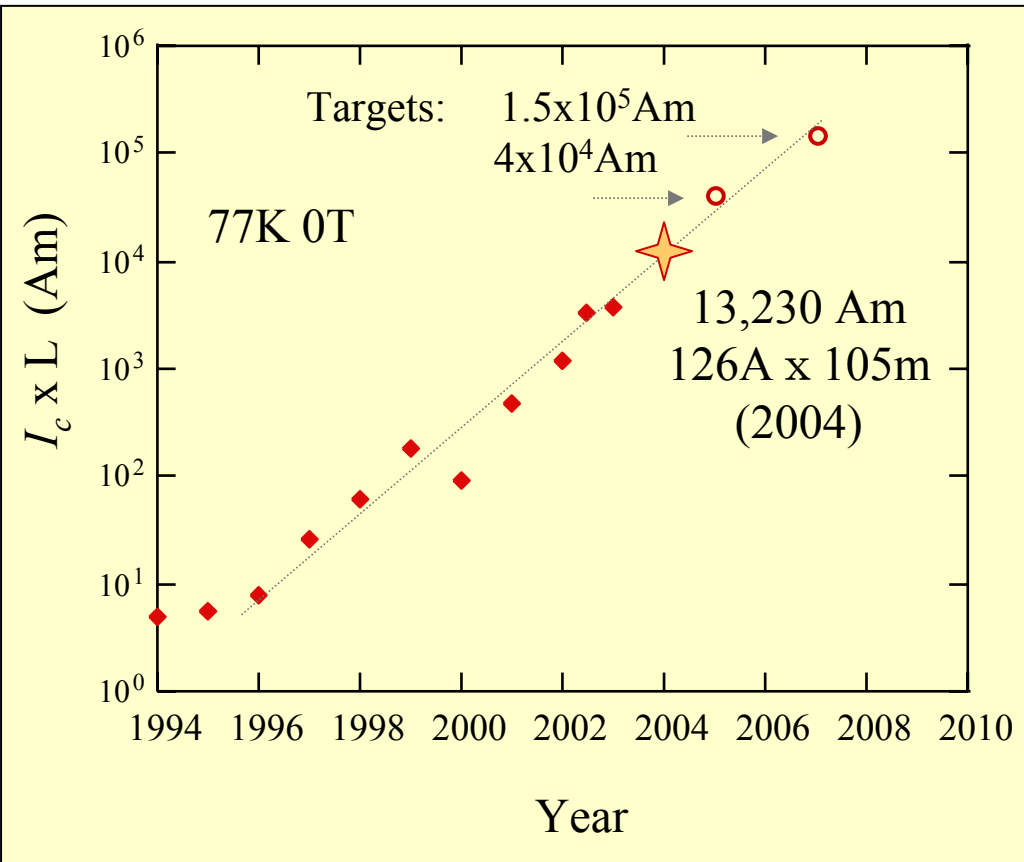
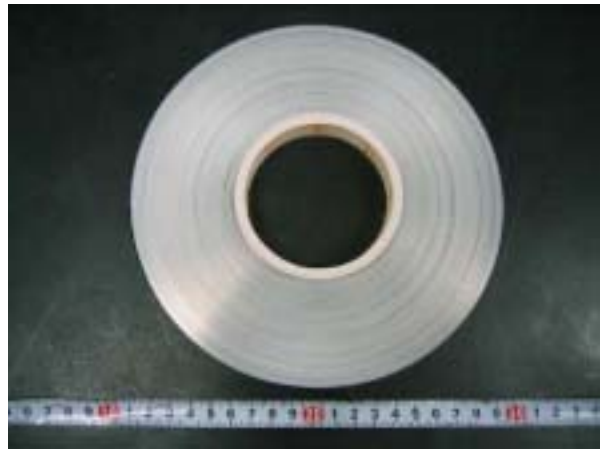
## Modified MOCVD

- Targeting single-pass, single buffer layer process
- Showed pilot production system
- Experiments all done on moving substrates
- 120 A/cm achieved on either IBAD or RABiTS (1.7- $\mu\text{m}$  YBCO)
- Meter length development at an early stage
- New short sample result: 265 A/cm on LANL IBAD substrate

# “High Performance Long Tape Processing”

105m Long Y-123 Tapes by PLD/IBAD  
(Fujikura)

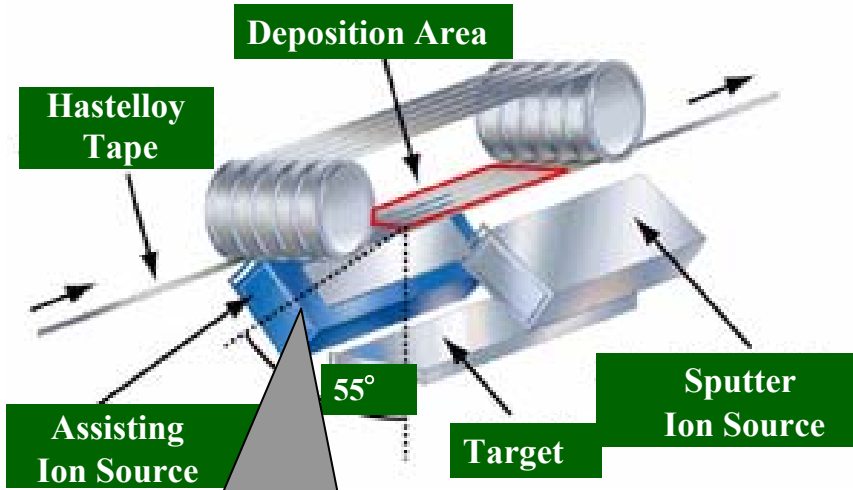
**$I_c \times L = 13,230 \text{ Am}$**



# “High Performance Long Tape Processing”

Large Scale IBAD-equipment for 500m Tapes  
(Fujikura)

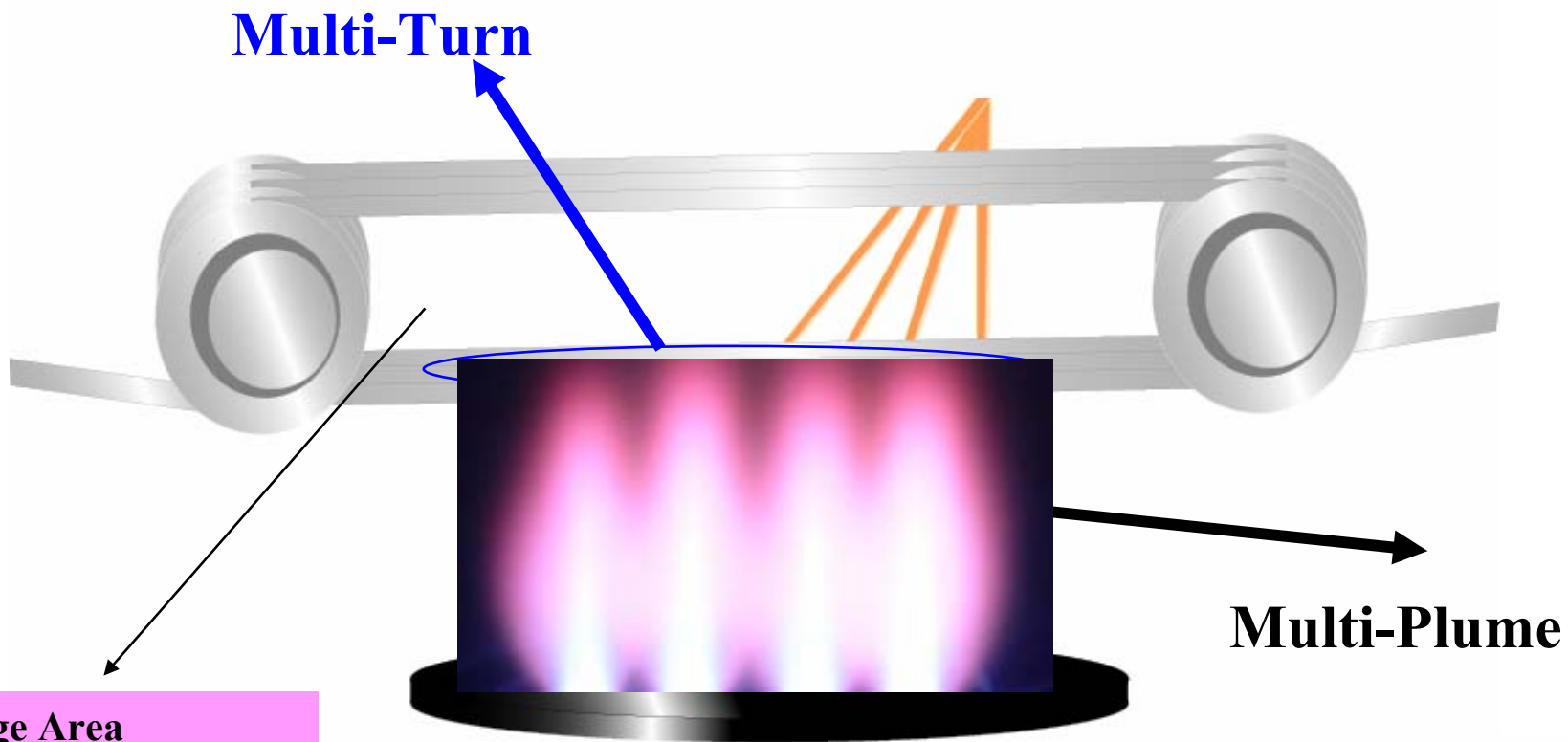
Large Area(100cm x 20cm)  
& Multi-turns  
▼  
**10m/h**



Large Ion-source (1m x 1.5m) Los Alamos

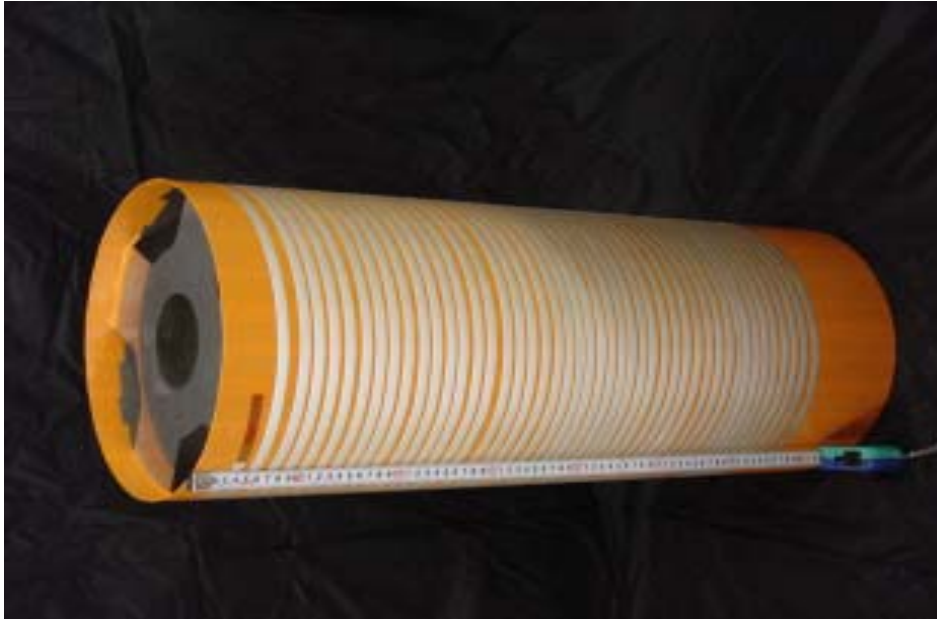
*“High Performance Long Tape Processing”*

# New Method of PLD-YBCO -Multi-Plume and Multi-Turn PLD- (SRL)



Large Area  
Deposition of YBCO

# Large $I_c \times L$ Coated Conductor (SRL)

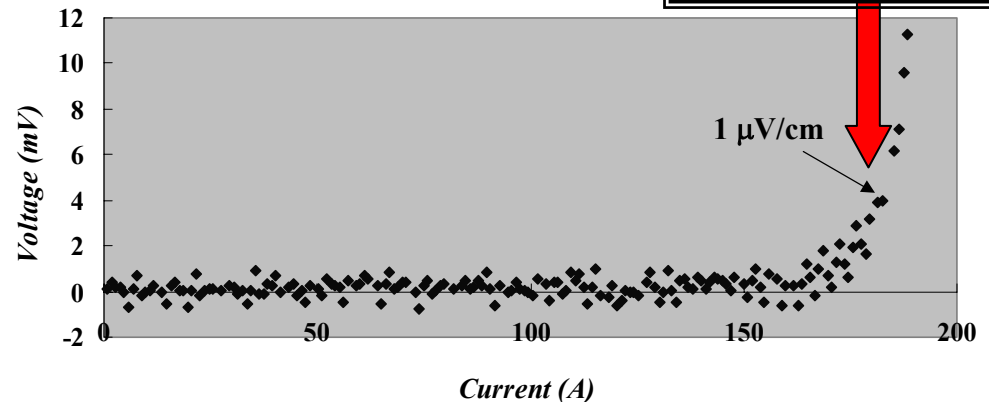


**Length=45.8m**  
 **$I_c=182A$  (77K, 0T)**

**Production Rate**  
**3 m/h**  
**(12 m/h / 4 times)**

**end-to-end  $I_c$**   
**182 A**

**$I_c \times L = 8340 Am$**

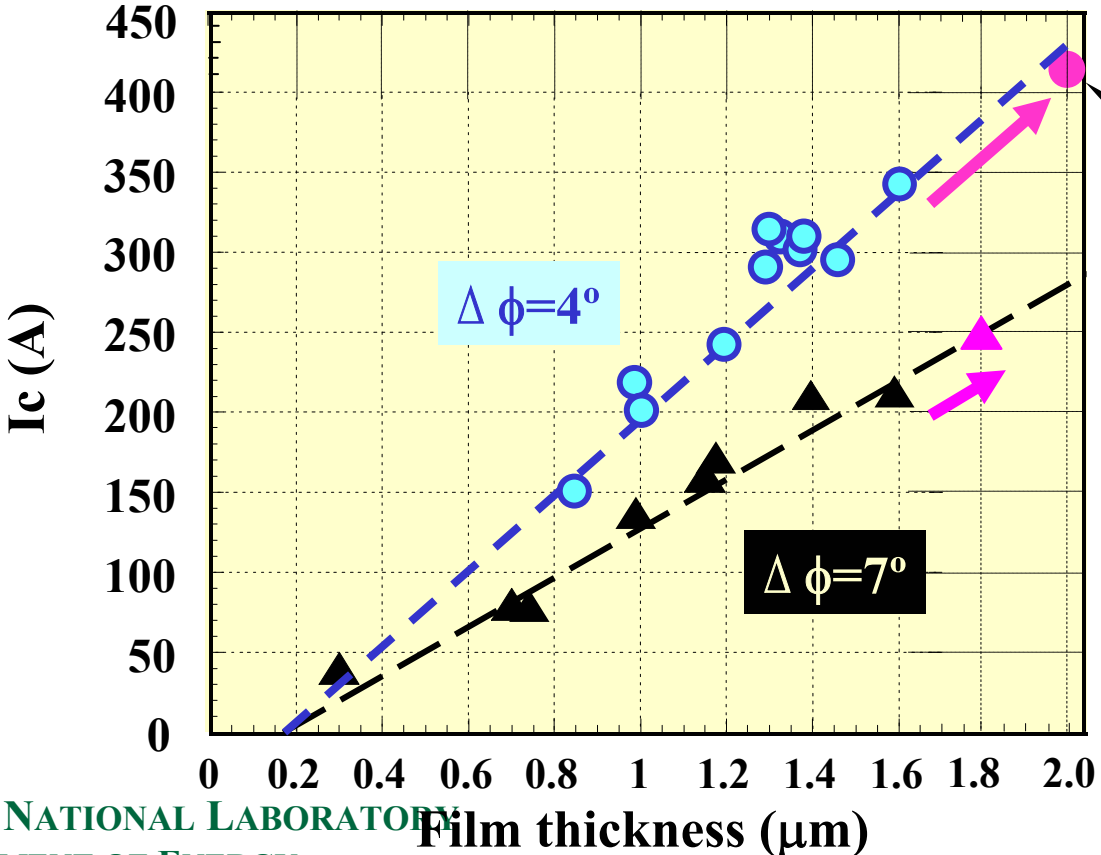


# Improvement of $I_c$ Values in TFA-MOD Process (SRL)

Low Heating Rate for Thick Film

&

Improvement of  $CeO_2 \Delta \phi = 7^\circ \rightarrow 4^\circ$



413A

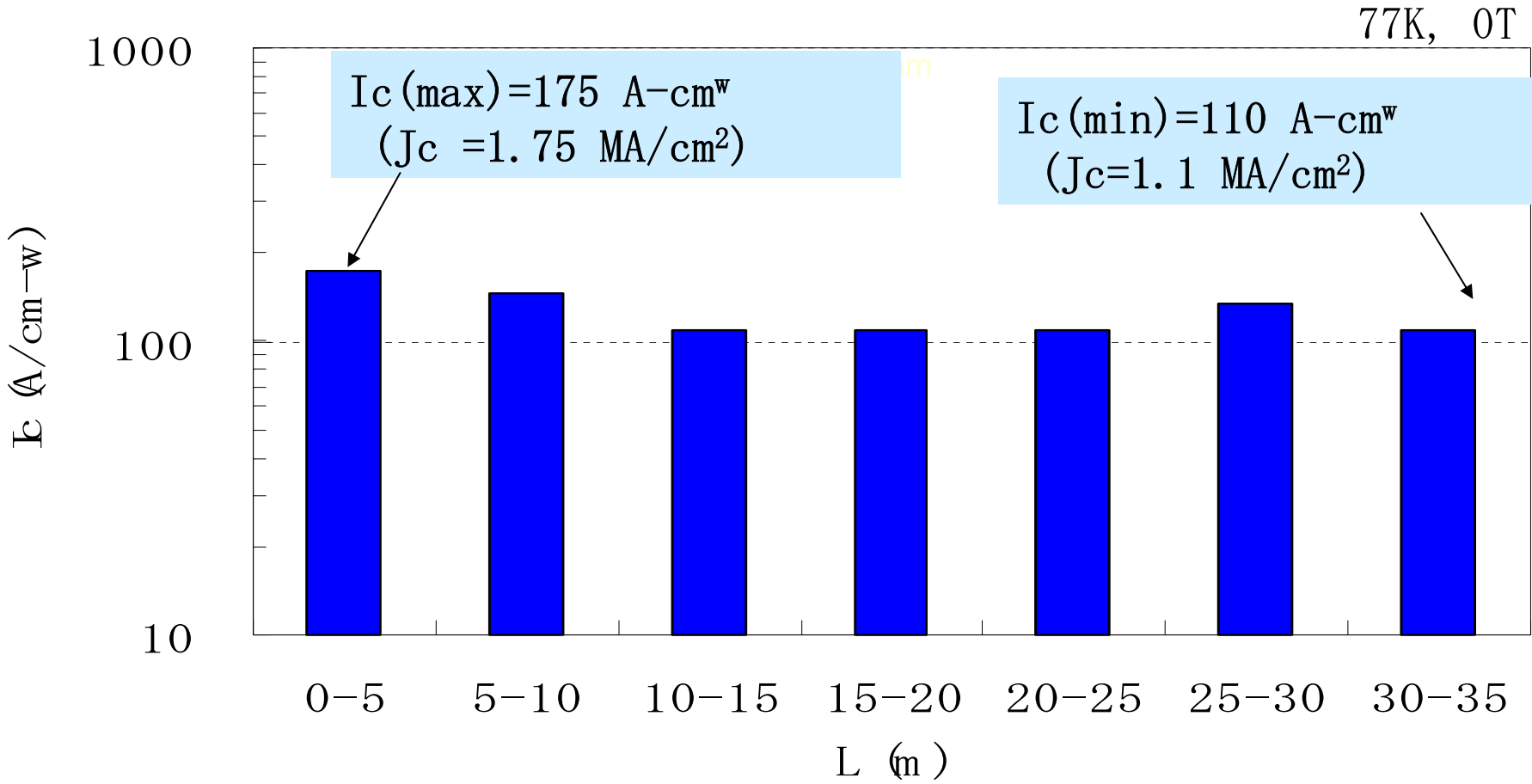
# “Low Cost Long Tape Processing- Sumitomo Electric Selects RABiTS Approach”

35m PLD-HoBCO Conductor (SEI)

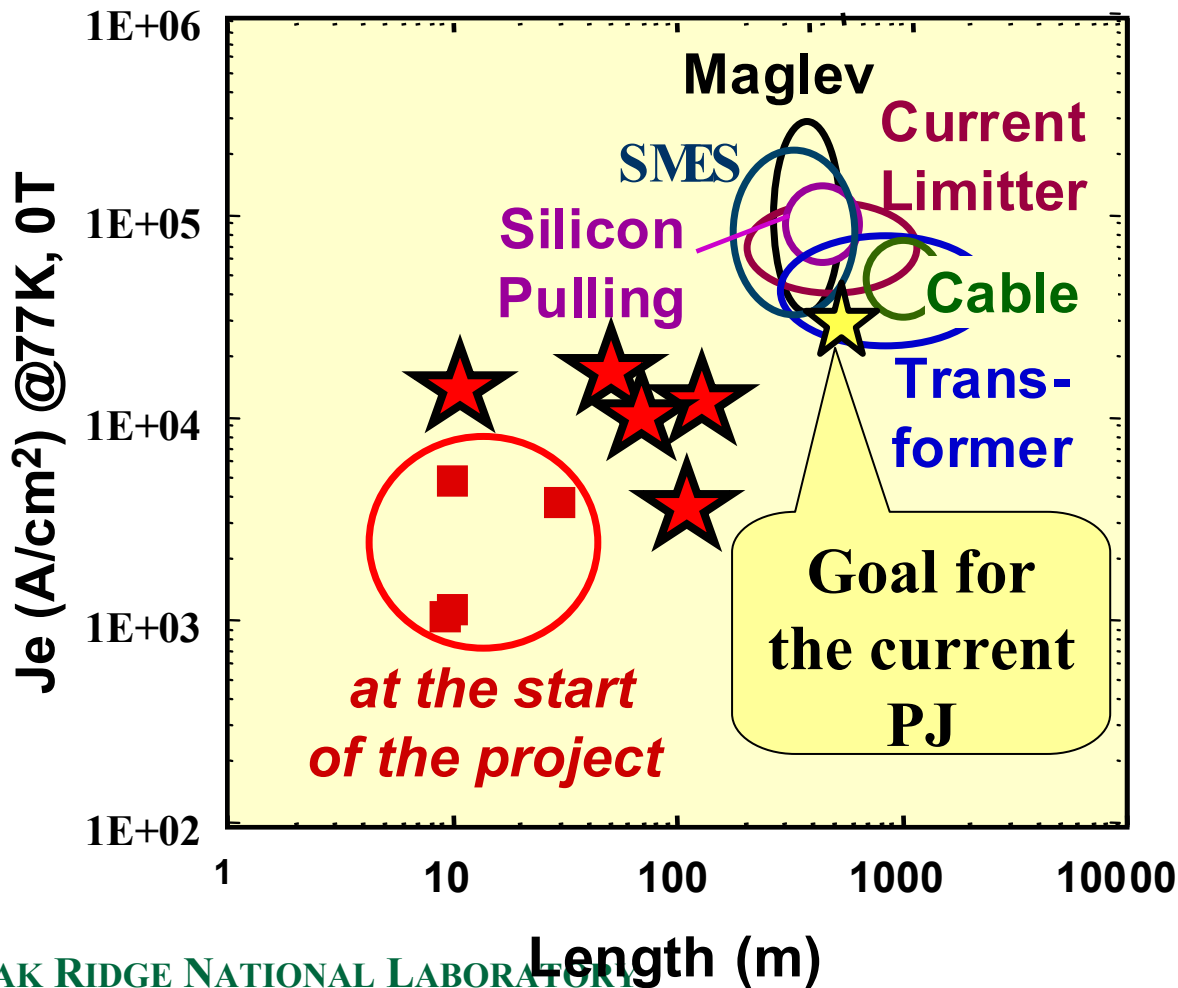
(PLD-HoBCO/CeO<sub>2</sub>/YSZ/CeO<sub>2</sub>/Ni-Alloy)

35m length, 1 $\mu$ m, I<sub>c</sub>=175~110 A-cm<sup>w</sup>

**Production Speed : 10 m/h x 3 times**



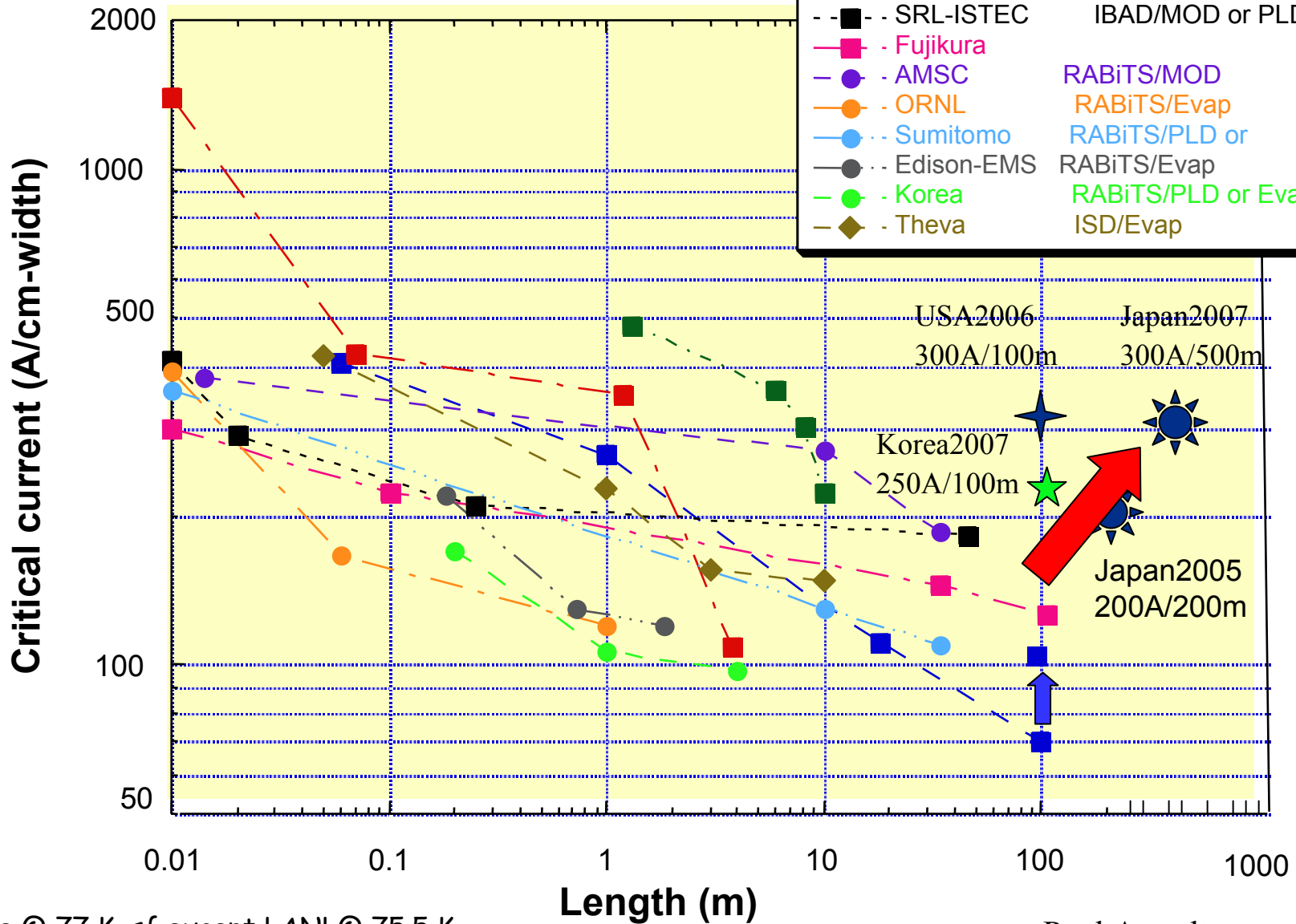
# Goals and Present Status of Japanese Coated Conductor Project (December 2004)



## Goal

**Length :  $\geq 500\text{m}$**   
**Cost :  $\leq 8-12/\text{Am}$**   
 **$J_c^*$  :  $\geq 300\text{A/cm-w}$**   
**Production Rate :  $\geq 5\text{m/h}$**

# Tape Ic vs. length



Data are @ 77 K, sf except LANL@ 75.5 K

Paul Arendt