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SWCC GROUP Creating for the Future

The Latest Trends of MOD REBCO Superconducting Coated Conductors in SWCC

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- Tokai university

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Today's topics

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1) Introduction

2) MOD REBCO coated conductor in SWCC.
   i) Development of in-house substrate for MOD.
   ii) Mass production of YBCO coated conductor.

3) Application of REBCO coated conductor in SWCC
   i) Development of compact superconducting current lead.
   ii) Development of High-T_c superconducting power cable.

4) Summary

Introduction

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REBCO coated conductors have developed using the metal-organic deposition process including trifluoroacetates so called TFA-MOD method since 1999.

Moreover, we have used a reel-to-reel process for calcination process and batch-type furnace for crystallization process.

In 2008, we successfully developed 500m-class YBCO coated conductors which had the critical current values of 310 A/cm-width at 77 K in self field.

Moreover, we successfully developed a way for introducing artificial pinning centers and fabricated 100m-class REBCO with artificial pinning centers. We named “nPAD-YBCO®”. nPAD-YBCO® means **n**ano-**P**article **A**rtificial-pinning-center **D**istributed **YBCO.**

MOD REBCO coated conductor

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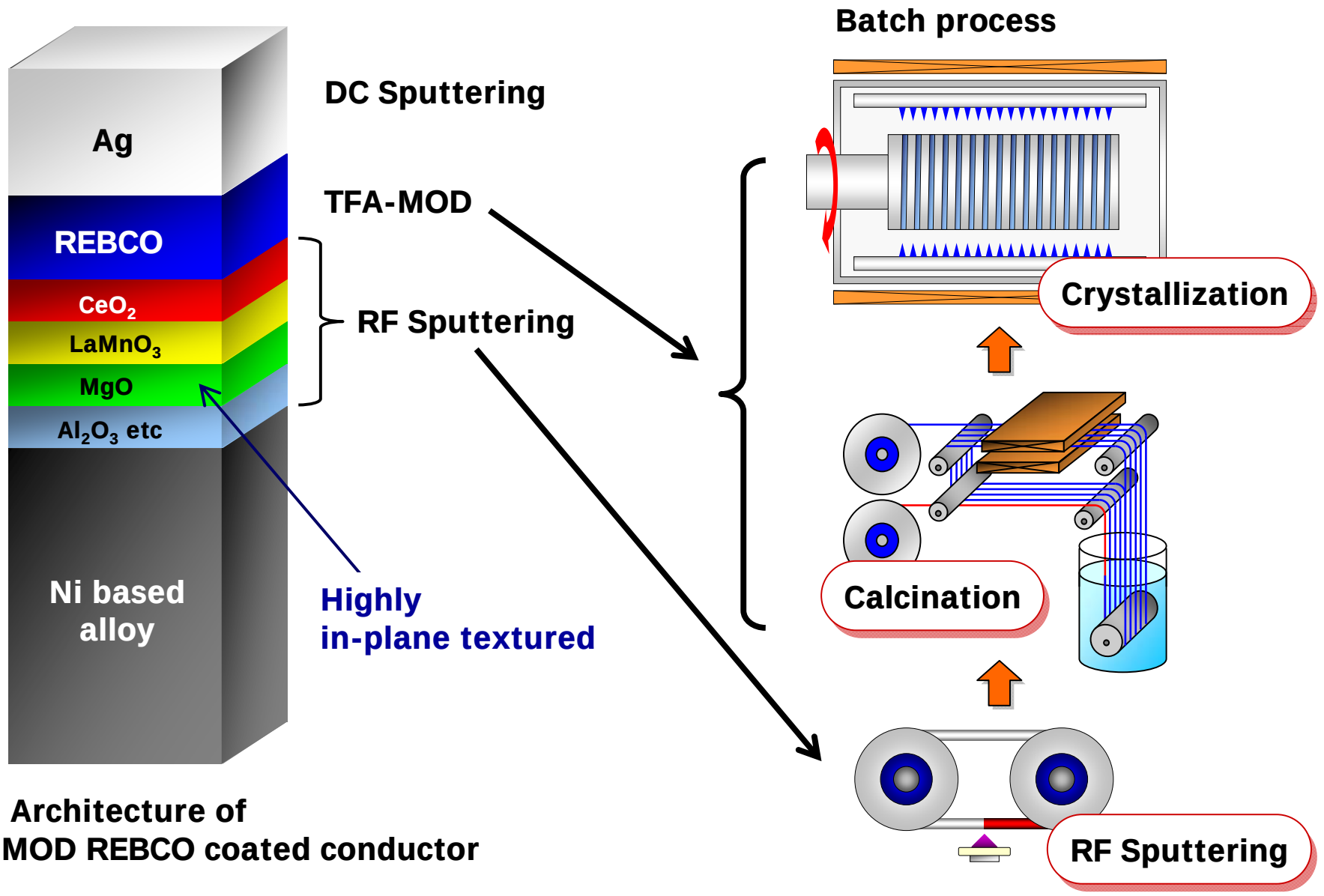

Architecture of MOD REBCO coated conductor

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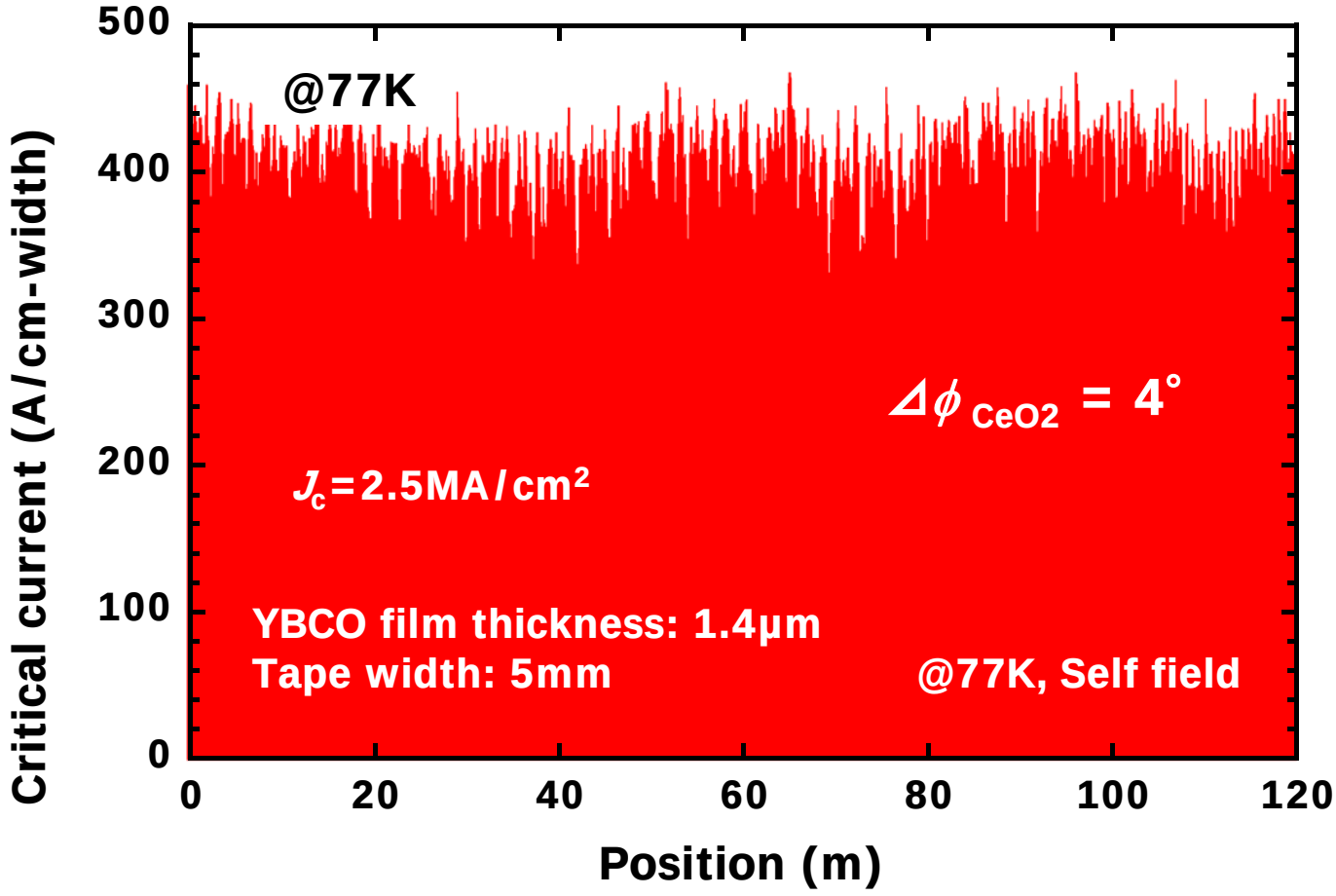
100m-class YBCO CC using in-house substrate

WTP-20 Y. Takahashi et. al.



We successfully developed in-house substrate.

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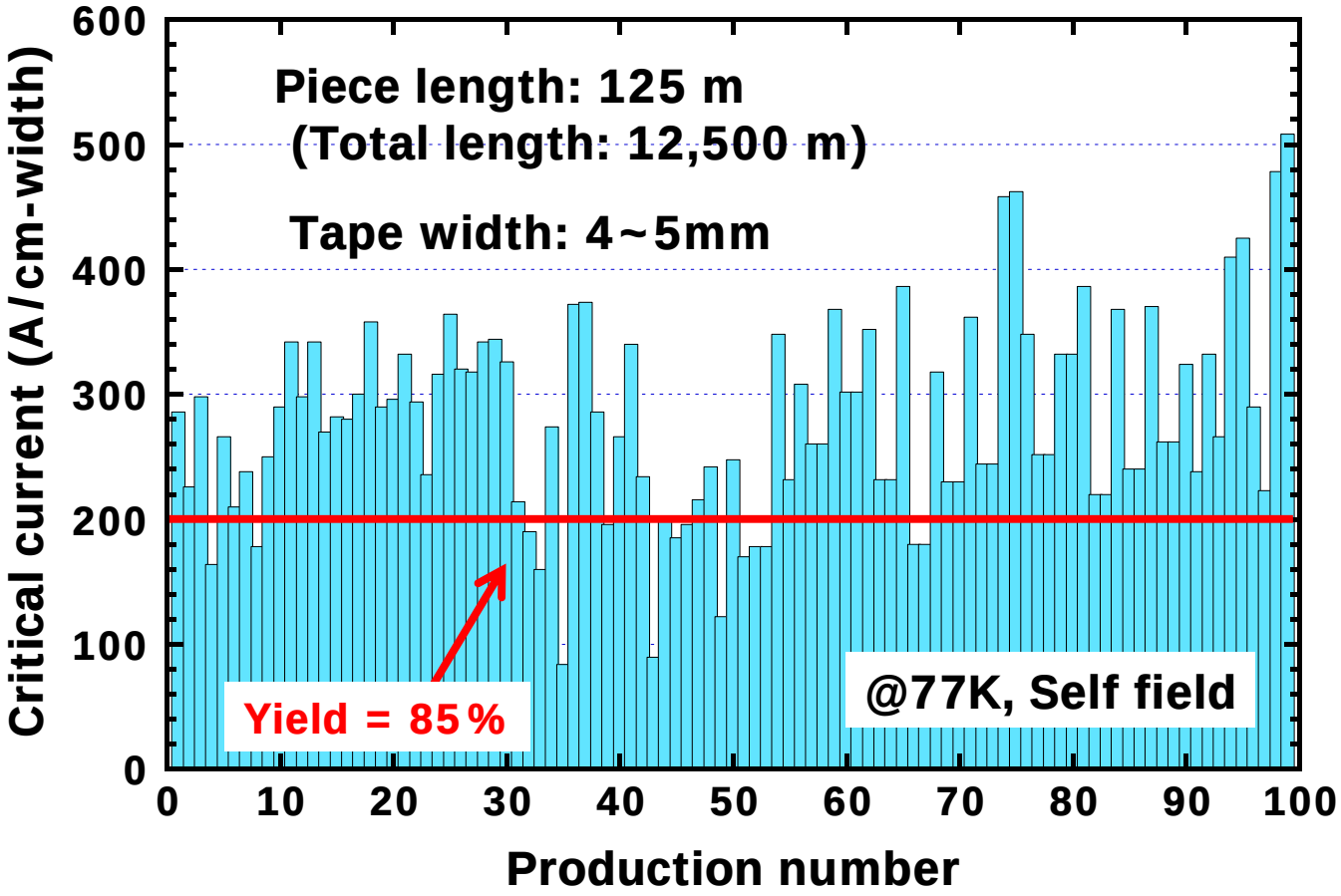
Production Results of 100m-class YBCO CC in 2014



We fabricated hundred pieces of 100m-long coated conductor. This yield was 80% more.

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High T_c Superconducting current lead

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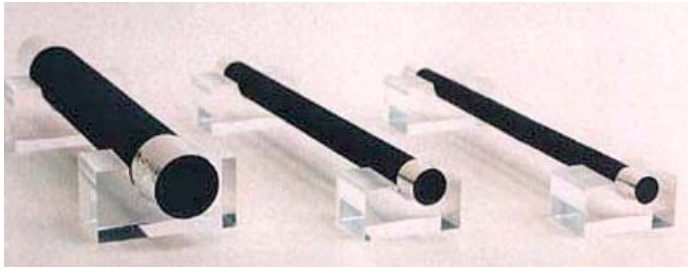
SAP-74 K. Takahashi et. al.

Bi-2223 Bulk Current lead



- Easy broken
- Expensive

Problem Solving

nPAD-YBCO® Current lead

- Compact
- Low heat leakage
- High mechanical performance

Widely available in various superconducting devices!

Lineup of nPAD-YBCO® current leads

Parameters	250A class	500A class	1500A class
Rated Current (@77K,self field)	250A	500A	1500A
Temperature range (K)	77K-4.2K		
Heat leakage (@77K-4.2K)	≦ 0.03W/piece	≦ 0.06W/piece	≦ 0.15W/piece
Supporting case	GFRP		
Size (mm)	220L×14W×14T	220L×14W×14T	220L×42W×14T

nPAD-YBCO®: nano-Particle Artificial-pinning-center Distributed YBCO

nPAD-YBCO® current lead

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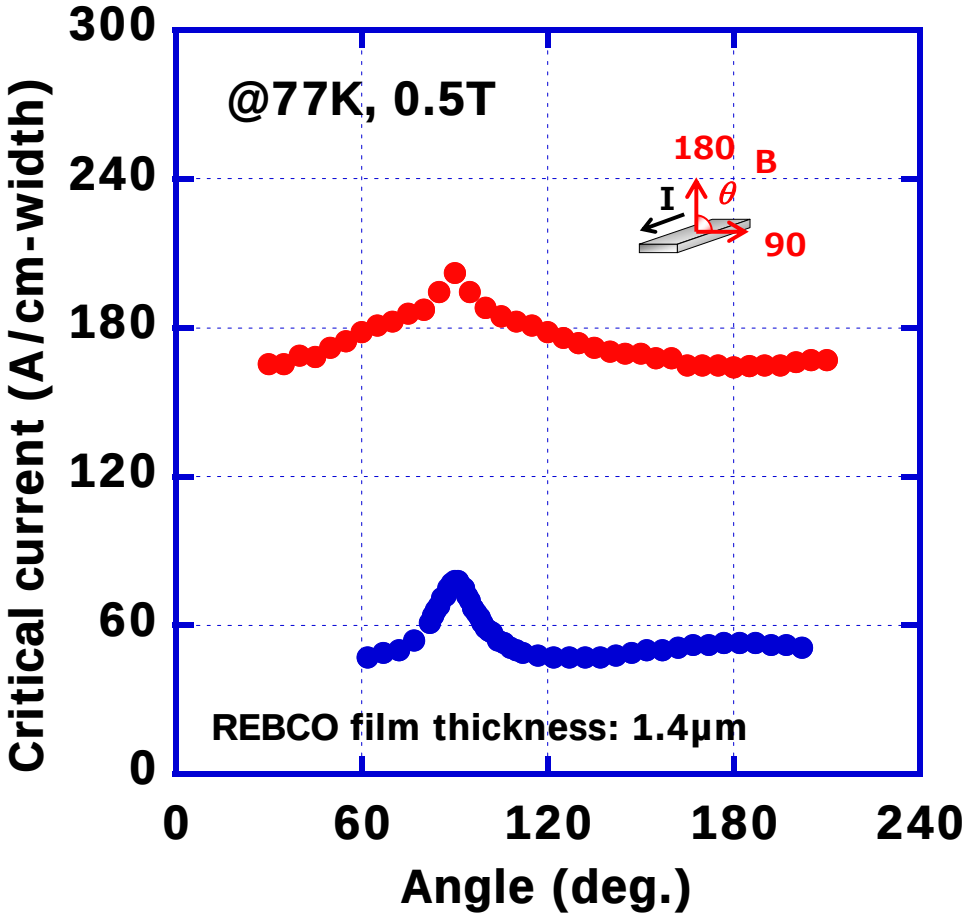
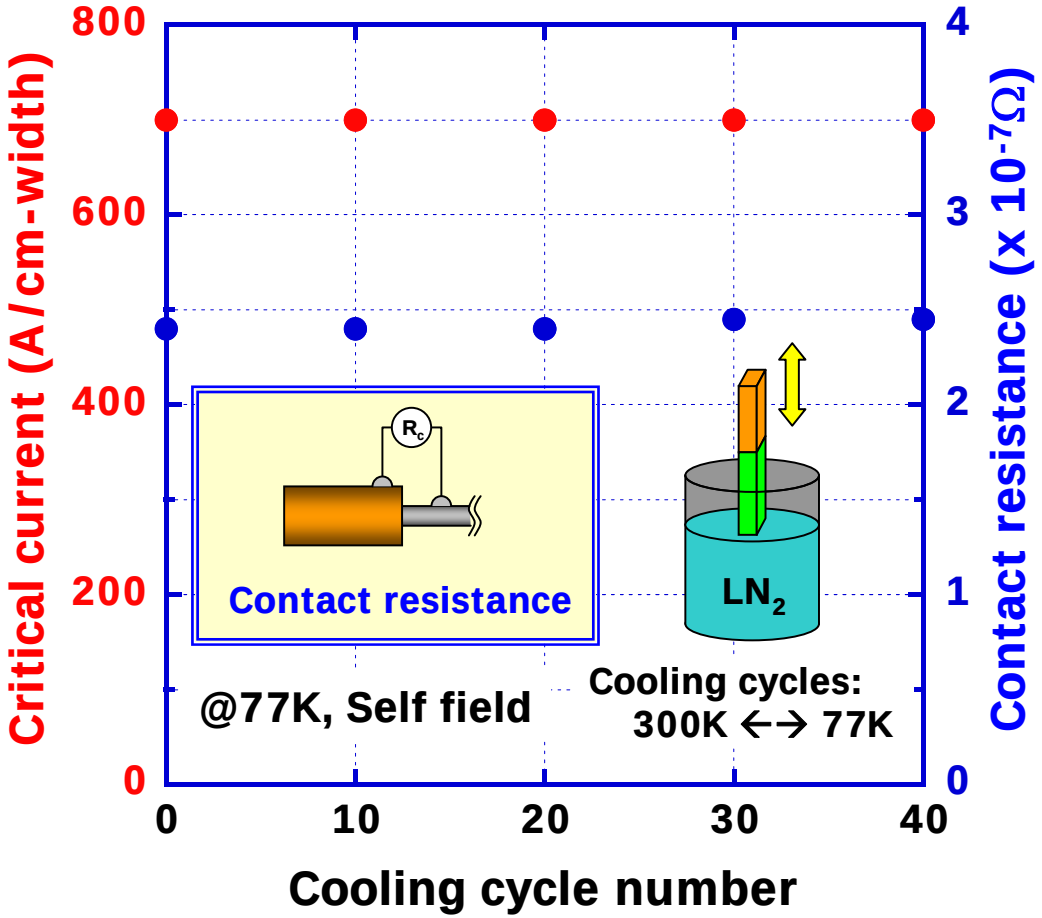


Angular dependence of critical current

In the case of used YBCO CC, we can not make a compact current lead. Because used many long tapes for overcome heart leakage dew to a YBCO CC was low I_c in a magnetic field.

However, in order to be able to develop nPAD-YBCO®, we successfully developed a compact current lead.

Cooling cycle test of nPAD-YBCO® Current Lead



We carried out cooling cycle test for the 500A class current read.

The measurement of I_c carried out until 40 cycles every 10 cycles .

As this result, I_c and R_c of the current lead were not damage until 40 cycles.

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Development of REBCO Power Cable

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Type	AC
Phases	3
Geometry	Coaxial
Voltage	35kV
Power	70MW
Length (Current PJ goal)	100m
I_{op}/I_c	0.5
HTS material	YBCO (MOD)
Diameter of conductor	30mm
Diameter of cable	130mm

Now, under several tests.

Summary

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- ✓ We successfully developed in-house substrate.
- ✓ We fabricated hundred pieces of 100m-long coated conductor. This yield was 80％ more.
- ✓ We successfully developed compact superconducting current lead using REBCO coated conductor.
- ✓ We started High-T_c superconducting power cable development.

Summary

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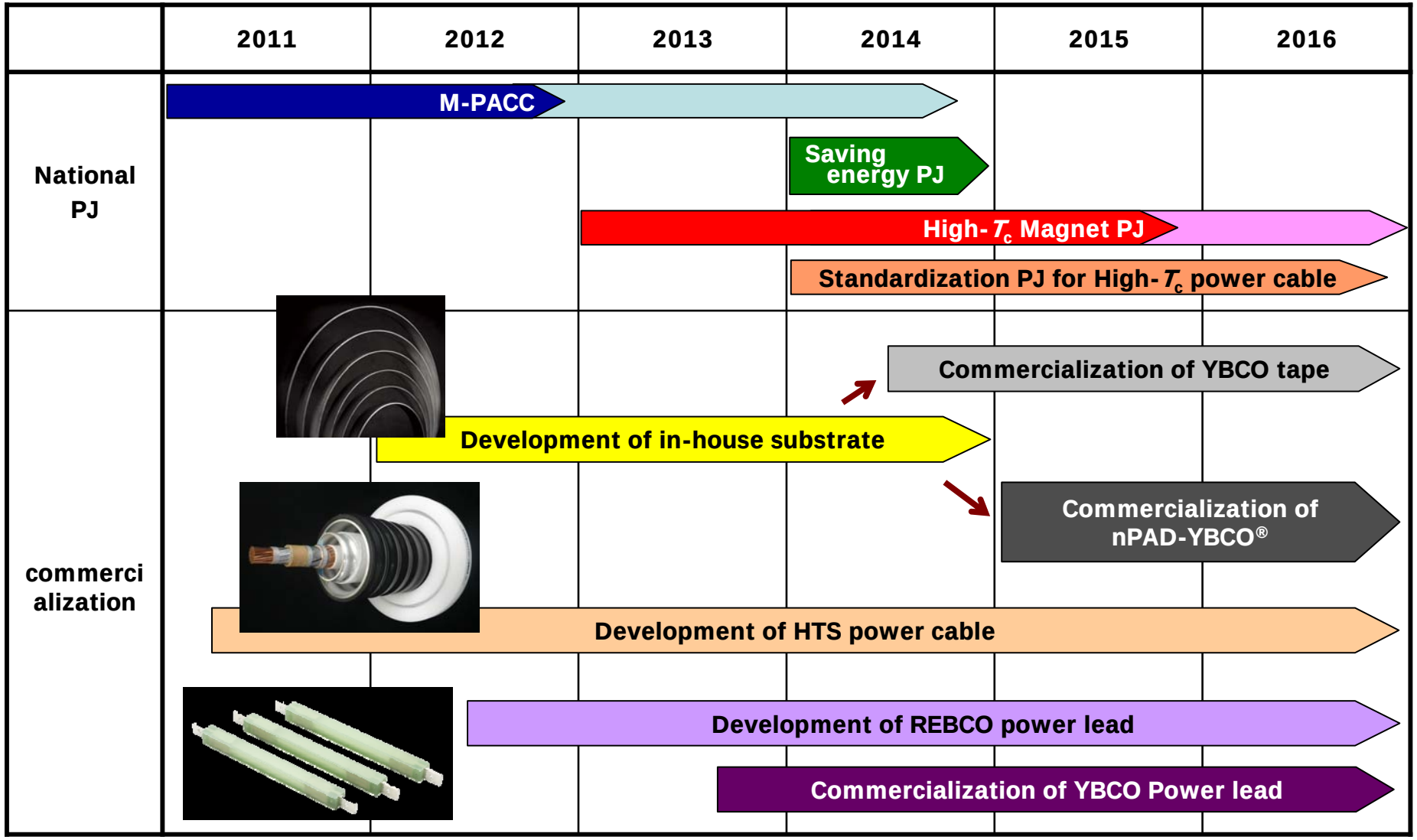
Development of business plans toward commercialization



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