

FCC Week 2015
Washington DC

Introduction of SH Copper Products Co., Ltd.

K. Miyashita

24th March 2015

Hitachi **Cable** merge into Hitachi **Metal** in 2013.

<About Superconducting Products & Accelerator Parts >

(1) Superconducting *wire & Accelerator Parts*

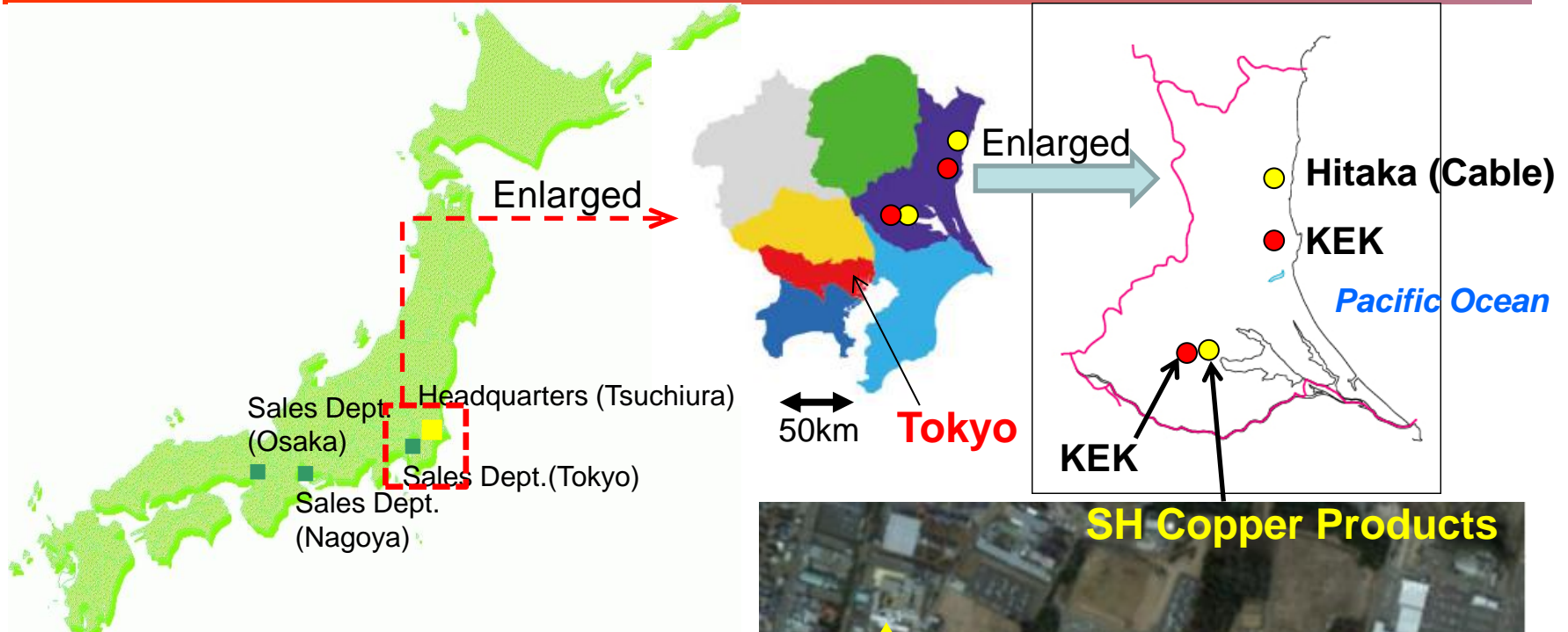
Former *Tsuchiura* factory in Hitachi Cable
change to **SH Copper products co., Ltd.**

SH Copper Products ; Hitachi **Metal** 50%

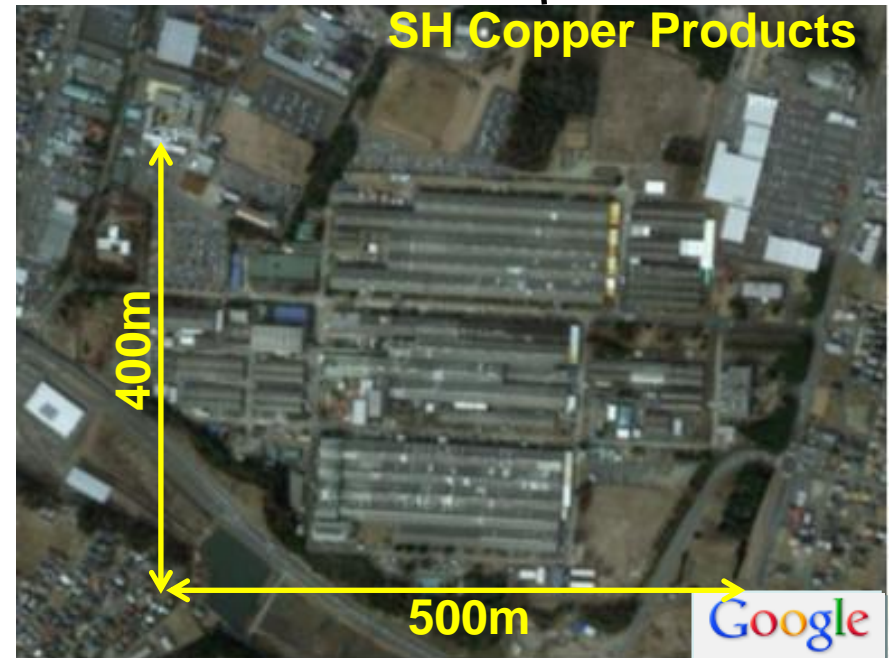
Sumitomo Metal Mining 50%

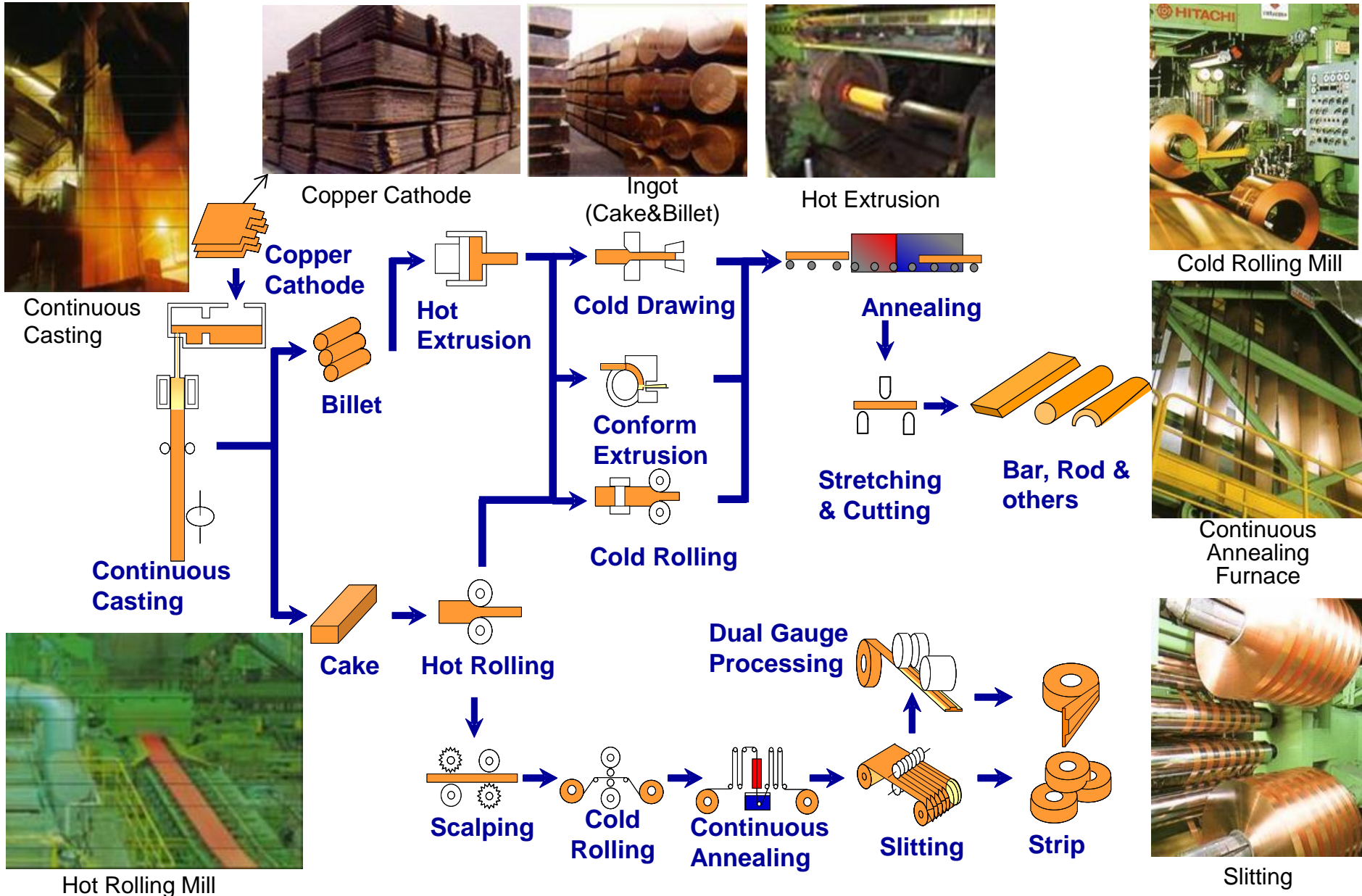
(2) Superconducting *Cable*

Former *Hitaka* factory in Hitachi Cable change
to *Hitaka* factory in Hitachi **Metal** .

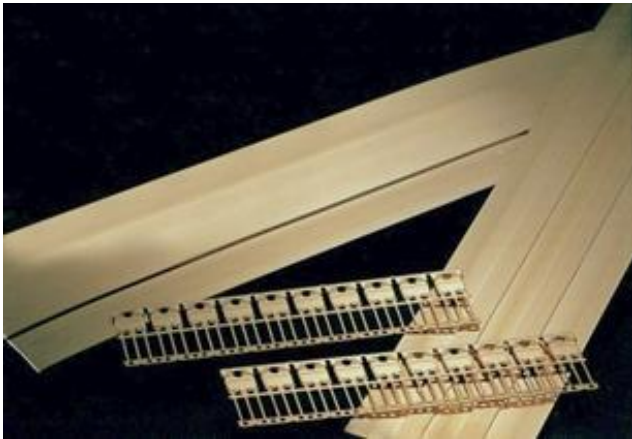


Item	Content
Name	SH Copper Products Co., Ltd.
Capital	1,000M¥/(10.7M\$)
Founded	March 1, 2013
Shareholder	Hitachi Metals (50%), Sumitomo Metal Mining (50%)
Employees	570
Products	Copper Strip, Rod, Bar, Fabricated Products and Superconducting Wires





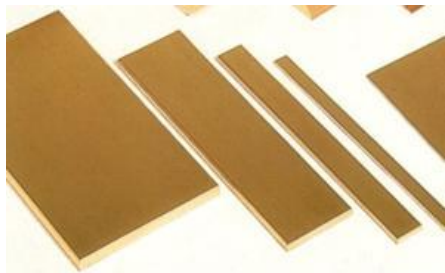
Major Products ; Copper strip & foil



Application

- Strips ; IC & Transistor Lead-frames
Transformer, Connector, Tape
Tele-communication Cables
- Copper Foil ; Lithium Ion Battery





Bus Bar



**Flexible Bus Bar
for Facilities**



Terminal



Formed Bar



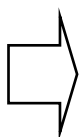
Commutator for Motor



**Formed Bar for
Electric Power
Facilities**



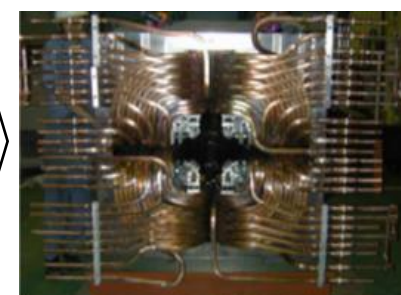
Round Rod



**Electrode for Vacuum
Interrupter**



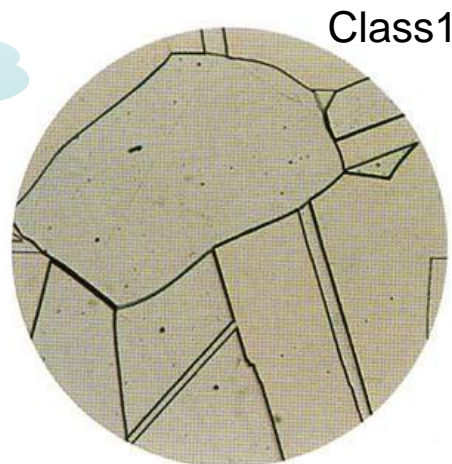
Hollow Conductor



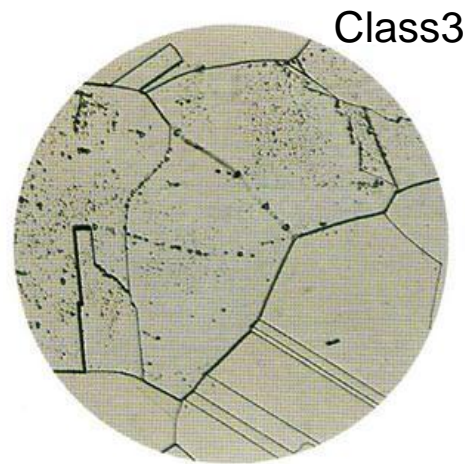
**Water Cooling
Electrical Magnet for
Particle Accelerator**

SH Copper Products can produce ASTM C10100 Class1 which contains lowest impurities in all copper.

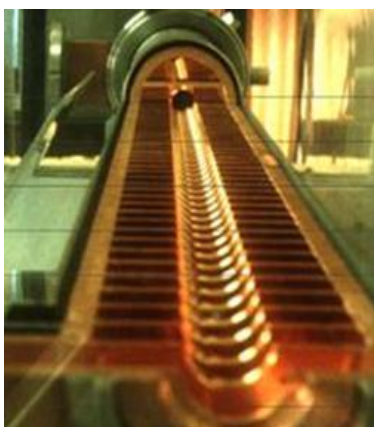
WW No.1



hydrogen content 0.3ppm



hydrogen content 0.6ppm



Accelerator for KEK

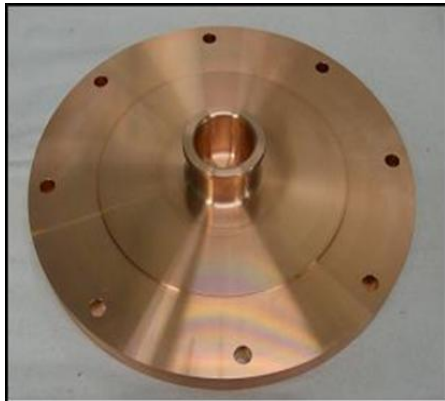
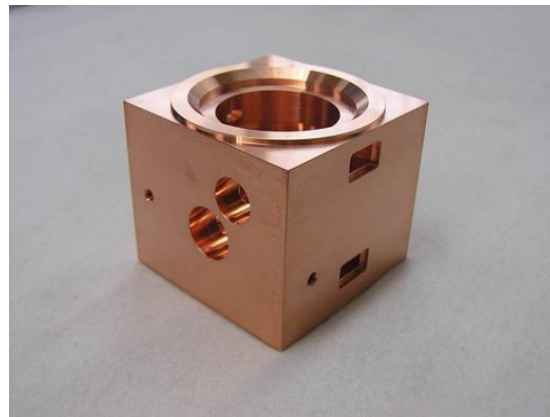


C-band Accelerating Tube



C-band Cell

Spring-8 / RIKEN's Institutes & Centers

Cavity for Accelerator**Electron Tube****Terminal for Vacuum Interrupter****Communication Equipment**

Features of Machined Products

- Five-axis machining centers and complex CNC lathes can produce complicated shapes.
- OFC, Class1 and other copper alloys can be available.

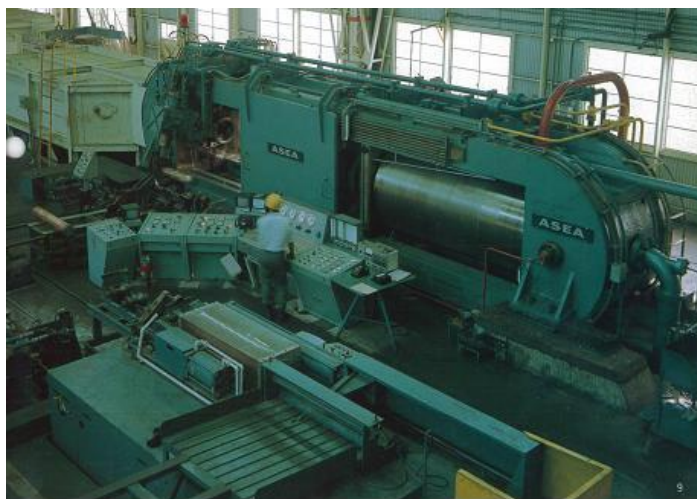
NbTi & Nb₃Sn Superconducting wires and cables

Characteristics

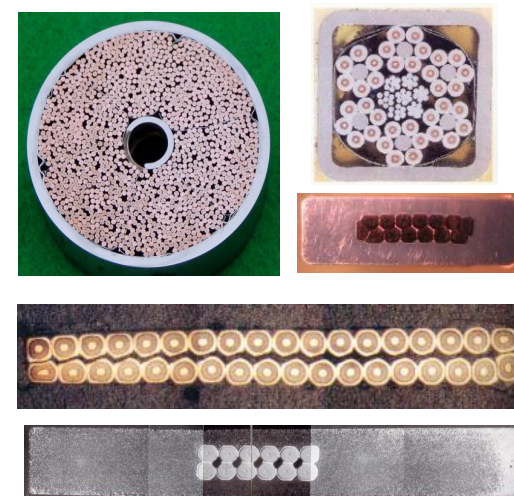
- High-quality Oxygen Free Copper
(Starting material (billet) $RRR \geq 250$)
- Hydrostatic extrusion press technology
(Uniform cross section of SC wires)
- Large current capacity NbTi & Nb₃Sn conductors



Cross section of ingot
(320mm dia.)

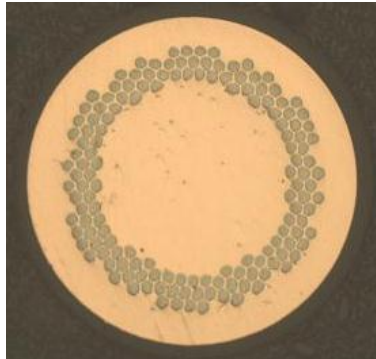


Over view of hydro static extruder

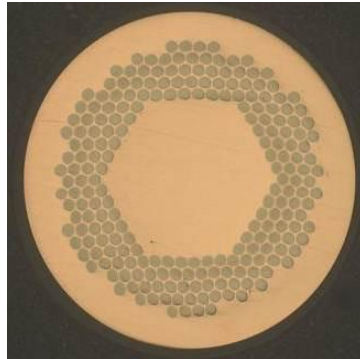


cables & conductors

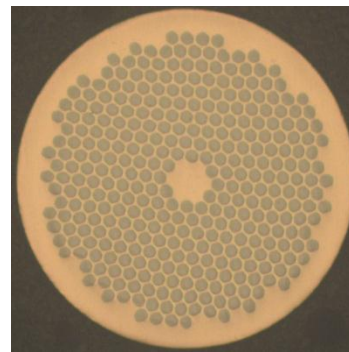
Various Round NbTi Wires



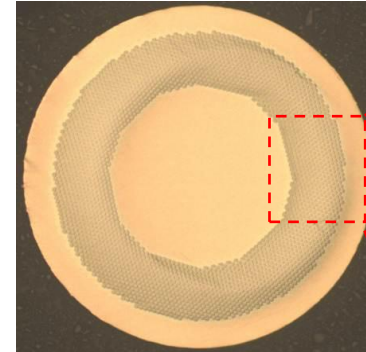
152 NbTi filaments
Cu ratio=4.3



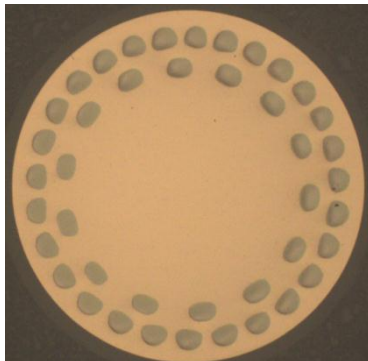
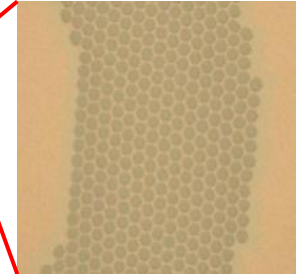
222 NbTi filaments
Cu ratio=2.4



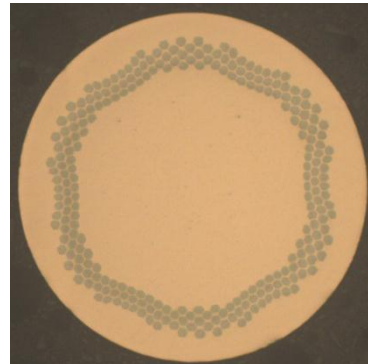
342 NbTi filaments
Cu ratio=1.0



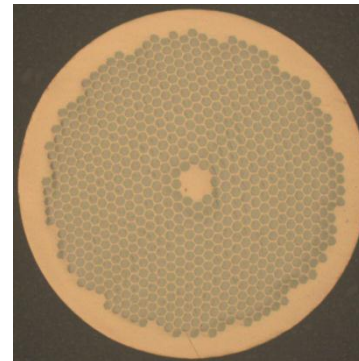
2446 NbTi filaments
(Cu+Cu10%Ni) ratio=2.3



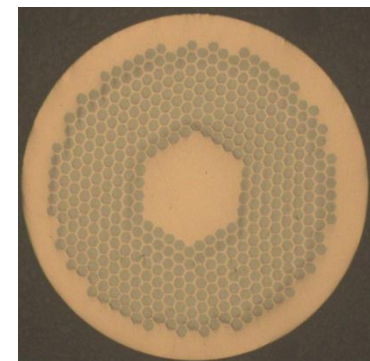
42 NbTi filaments
Cu ratio=4.3



234 NbTi filaments
Cu ratio=6.0



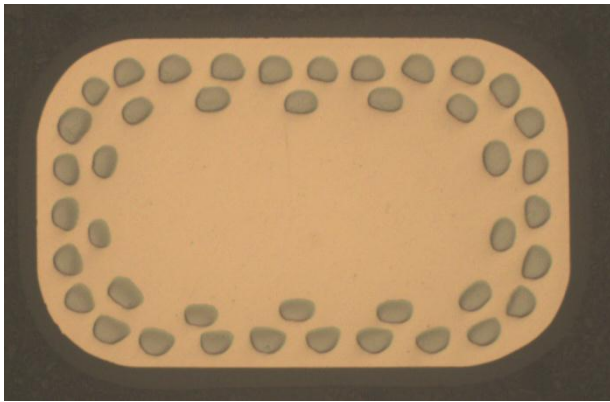
738 NbTi filaments
Cu ratio=0.96



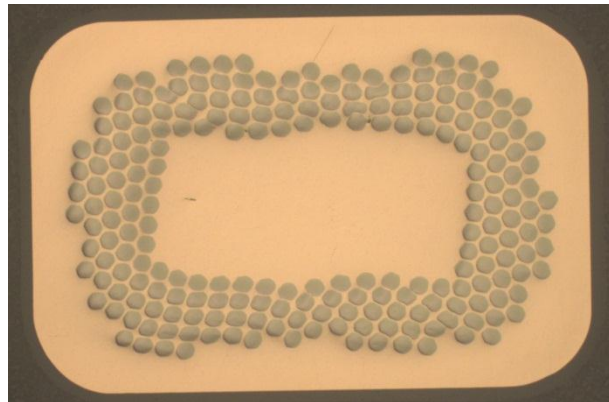
444 NbTi filaments
Cu ratio=1.35

Varnish (Enamel) ; Hitachi Magnet Wire (HMW)

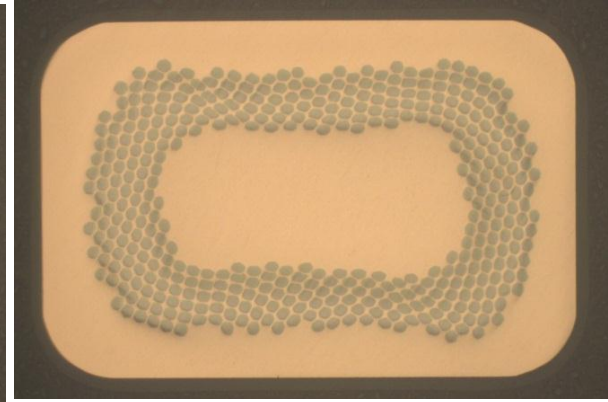
Various Rectangular NbTi Wires



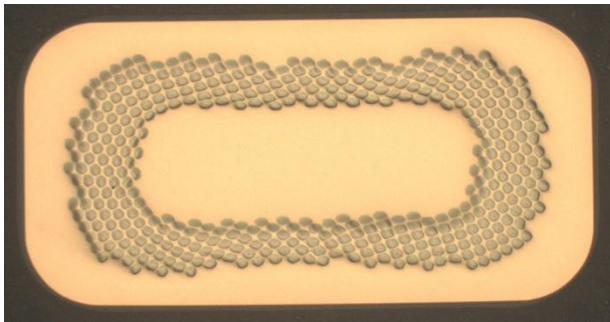
0.92X1.48mm, 42 filaments



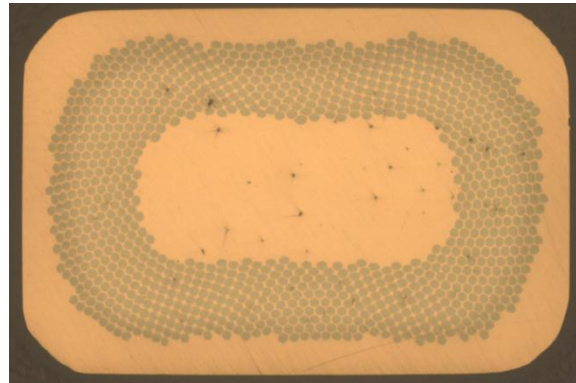
1.4X2.1mm, 222 fil.



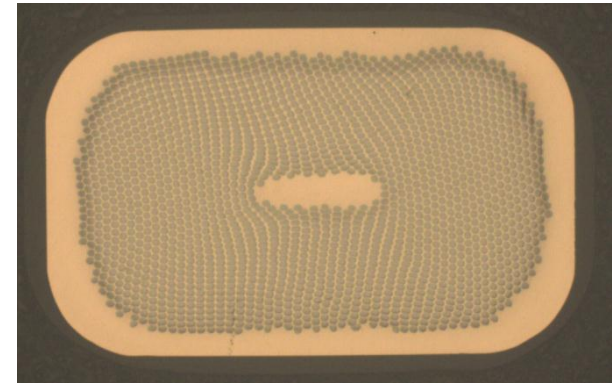
1.4X2.1mm, 414 fil.



2.0X4.0mm, 414 fil.



0.8X1.2mm, 1032 fil.



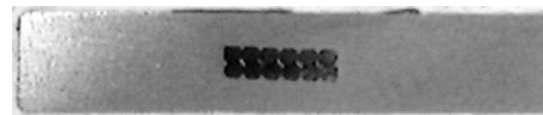
1.07X1.73mm, 1812 fil.

ATLAS (CERN)



4.3^t X 30^w mm
 1.23 dia. X 12 strand
 Al : Cu : NbTi = 15.6 : 0.9 : 1
 I_c = 21 kA at 5T

BES III (IHEP)



3.73-3.67^t X 20^w mm
 0.7 dia. X 12 strand
 Al : Cu : NbTi = 28.2 : 0.9 : 1
 I_c = 7.4 kA at 4T

COMET (KEK)



4.7^t X 15^w mm
 1.21 dia. X 14 strand
 Al : Cu : NbTi = 7.4 : 1 : 1
 I_c = 17.5 kA at 5T

Mu2e (FNAL)

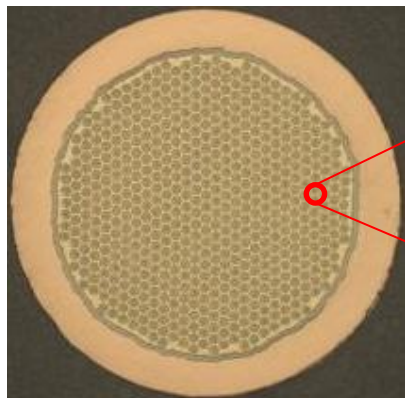


3.11^t X 9.85^w mm
 0.67 dia. X 14 strand
 Al : Cu : NbTi = 11 : 1 : 1
 I_c = 5.9 kA at 5T

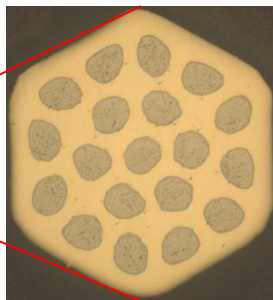


7^t X 20^w mm
 1.3 dia. X 8 strand
 Al : Cu : NbTi = 24 : 1 : 1
 I_c = 12.5 kA at 5T

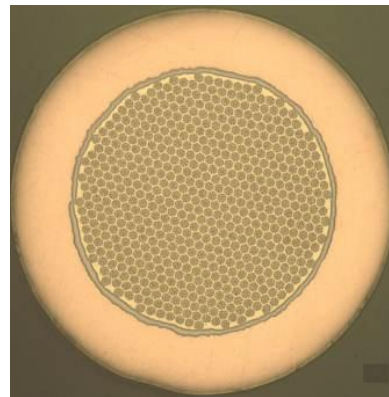
Various Round & Rectangular Nb₃Sn Wires



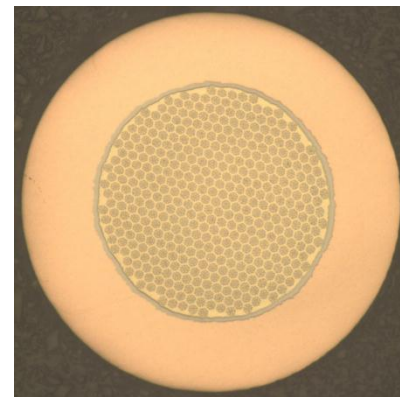
19 x 583 = 11077 filaments
Cu ratio ; 0.55



Sub element
(19 Nb filaments)
Cu-14.3~16wt%Sn-0.3%Ti

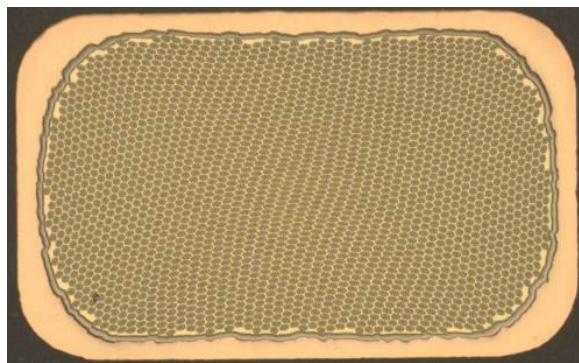


18145 filaments
Cu ratio ; 1.0

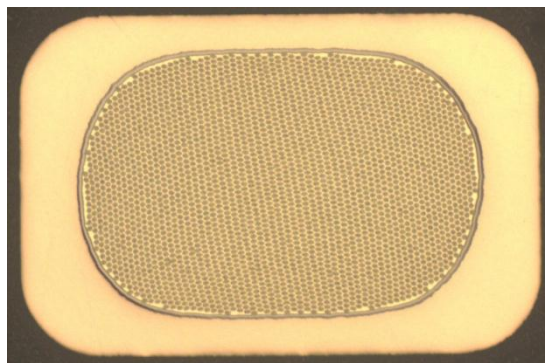


7125 filaments
Cu ratio ; 1.5

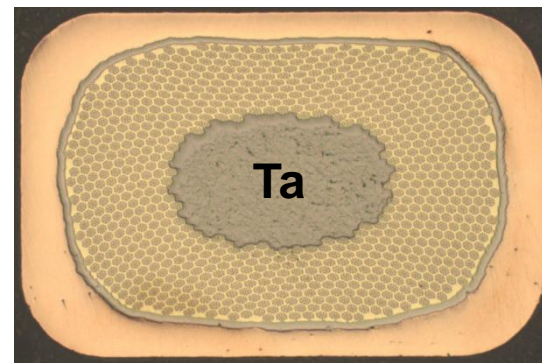
Non Cu Jc=1000A.mm² at 12T



41971 filaments
Cu ratio ; 0.3

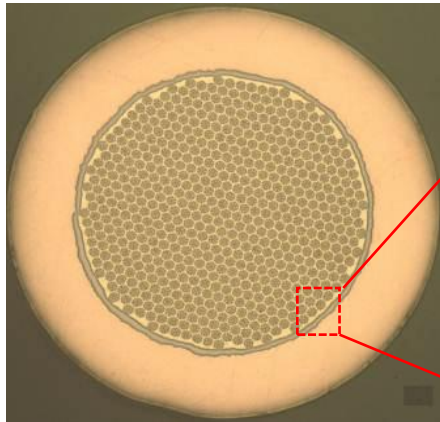


51547 filaments
Cu ratio ; 0.9

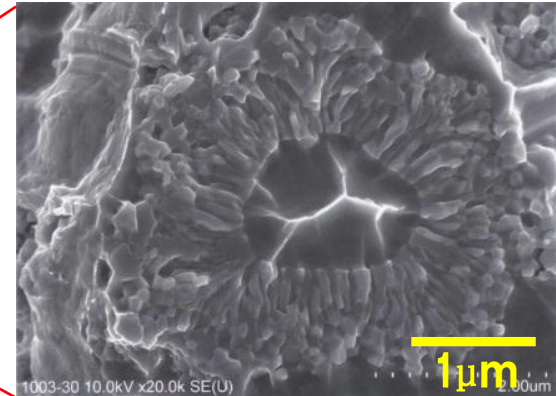
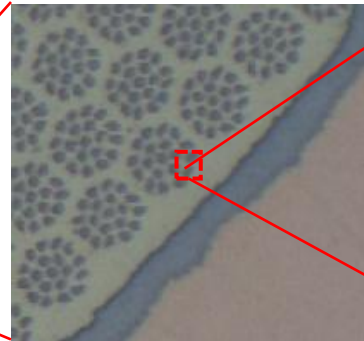


15162 filaments
Cu ratio ; 0.5
Ta reinforced
0.2% proof ; >270MPa

More than 70 ton Nb₃Sn wires were manufactured for ITER project from 2009 to 2013.



ITER/TF Nb₃Sn wire (0.82mm dia. with Cr plating)



SEM Photo of Nb₃Sn filament (After Heat Treatment)

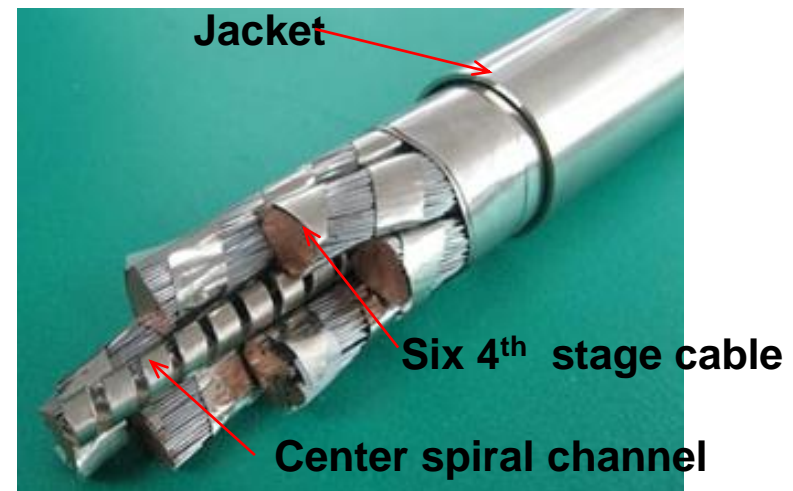


Jacket

5th stage cable
(900 SC wires)

48mm

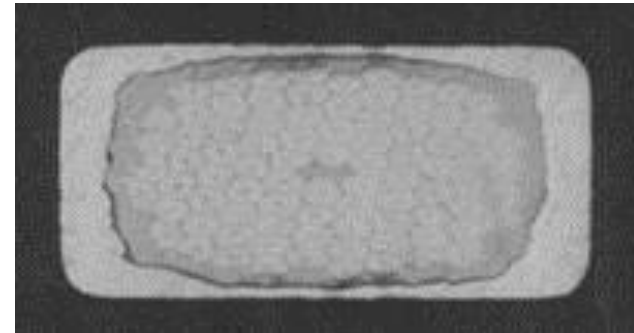
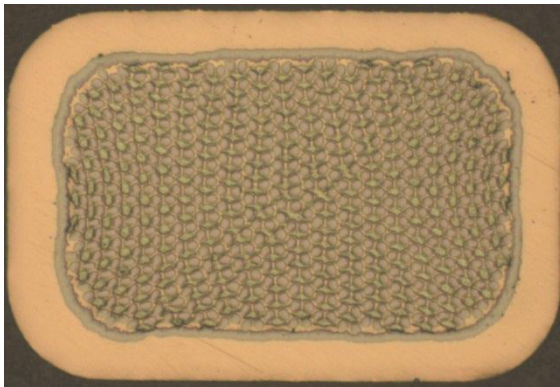
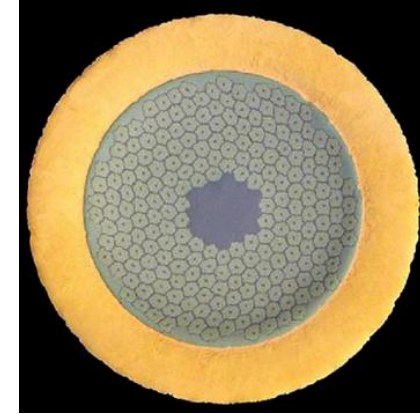
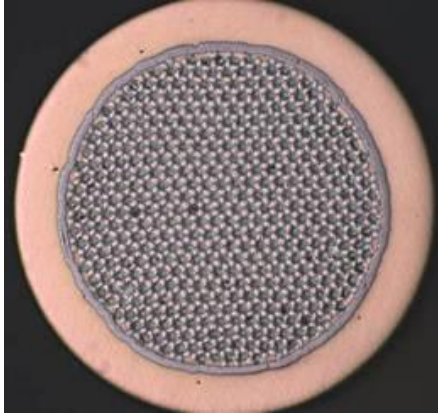
ITER/TF Nb₃Sn CICC (I_{op}=68kA at 12T)
Wires ; SH Copper, Cabling ; Hitachi Metal,
Jacketing; Nippon steel & Sumikin Engineering
Quotation from Japan Atomic Energy Agency



Jacket

Six 4th stage cable

Center spiral channel



Internal tin Nb₃Sn

- Small Sn filaments
- $\geq 400\text{A/mm}^2$ at 18T
- 14km Class wire

Rapid quench method Nb₃Al (Under development with NIMS)

- High Strain vs I_c Property

Thank you