

Recent advances in SuperOx 2G HTS wire manufacturing facilities, performance and customisation

- The SuperOx group
- Production technology and capacity
- Wire for LN2
- Wire for in-field use
- Laser slitting technology

S Innovations (Moscow) and **SUPEROX JAPAN** (Tokyo)

- 2G HTS wire production and development
 - Supply wire to SuperOx projects
 - Supply wire to outside customers



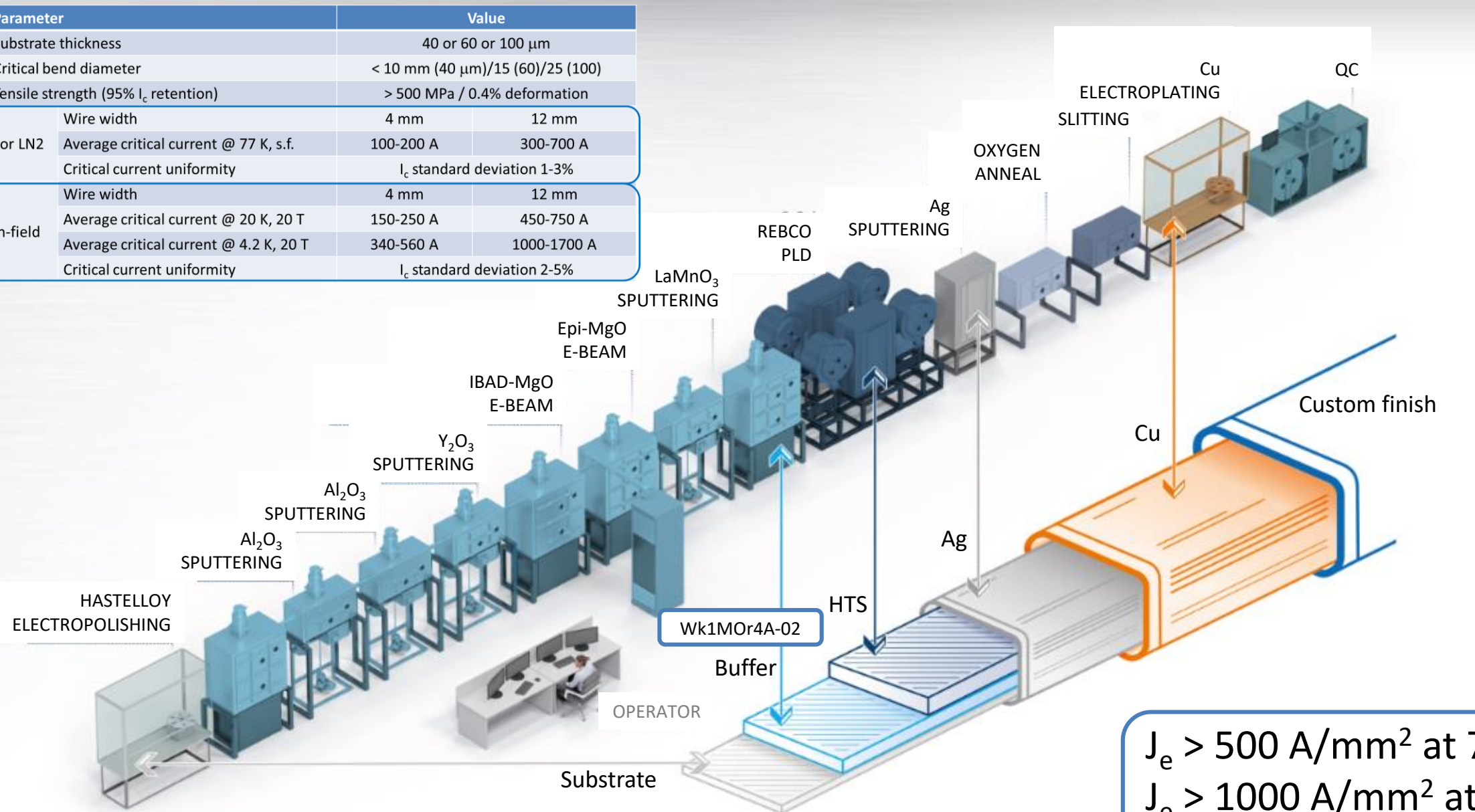
SuperOx (Moscow)

- HTS Applications development and commercialisation
 - FCL: first in the world resistive FCL, in Moscow city grid since 2019 **Wk2L0r3E-01**
 - AC/DC cables
 - Coils



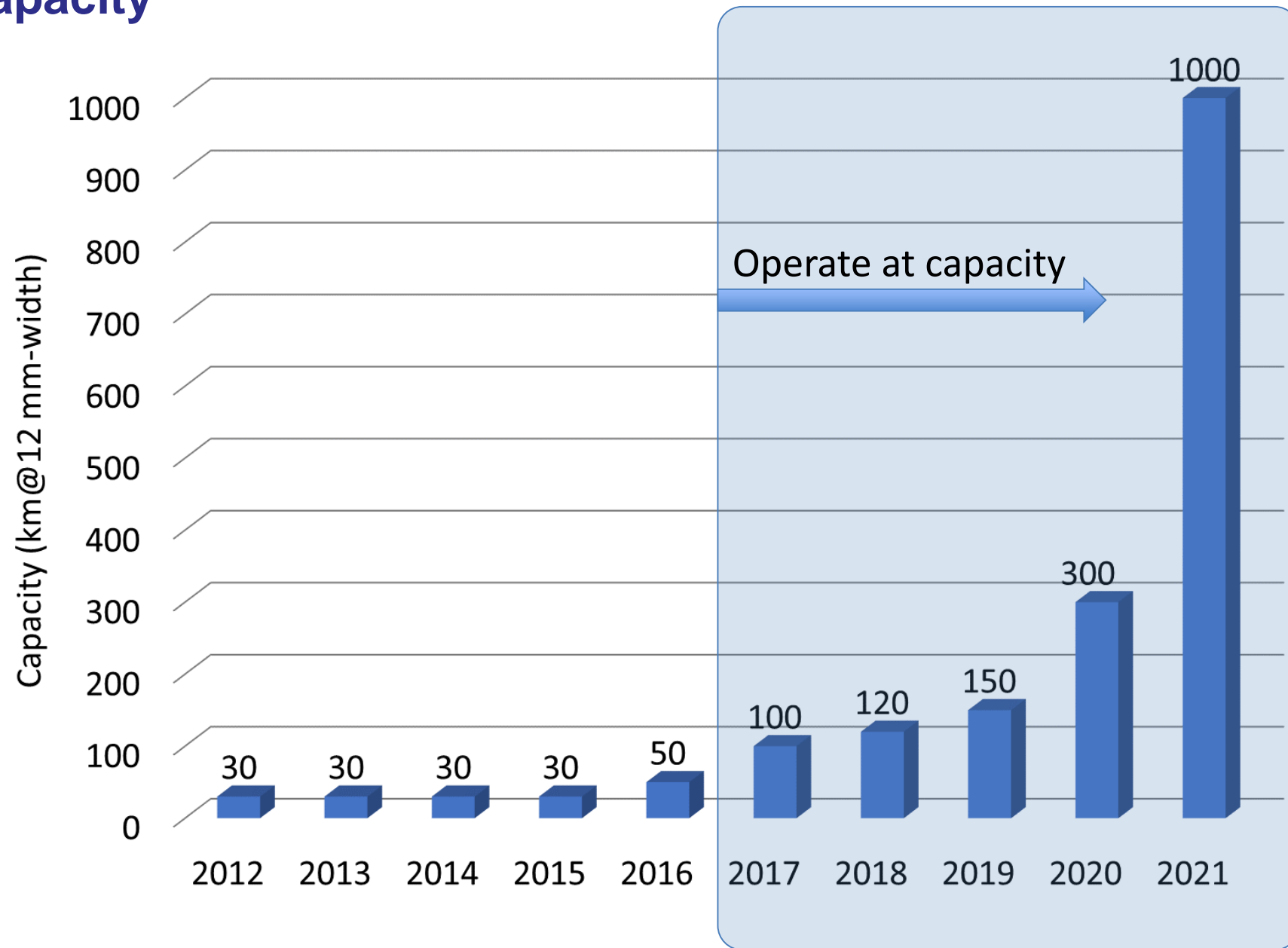
SuperOx 2G HTS wire: Technology

Parameter	Value	
Substrate thickness	40 or 60 or 100 μm	
Critical bend diameter	< 10 mm (40 μm)/15 (60)/25 (100)	
Tensile strength (95% I_c retention)	> 500 MPa / 0.4% deformation	
For LN2	Wire width	4 mm 12 mm
	Average critical current @ 77 K, s.f.	100-200 A 300-700 A
	Critical current uniformity	I_c standard deviation 1-3%
In-field	Wire width	4 mm 12 mm
	Average critical current @ 20 K, 20 T	150-250 A 450-750 A
	Average critical current @ 4.2 K, 20 T	340-560 A 1000-1700 A
Critical current uniformity	I_c standard deviation 2-5%	



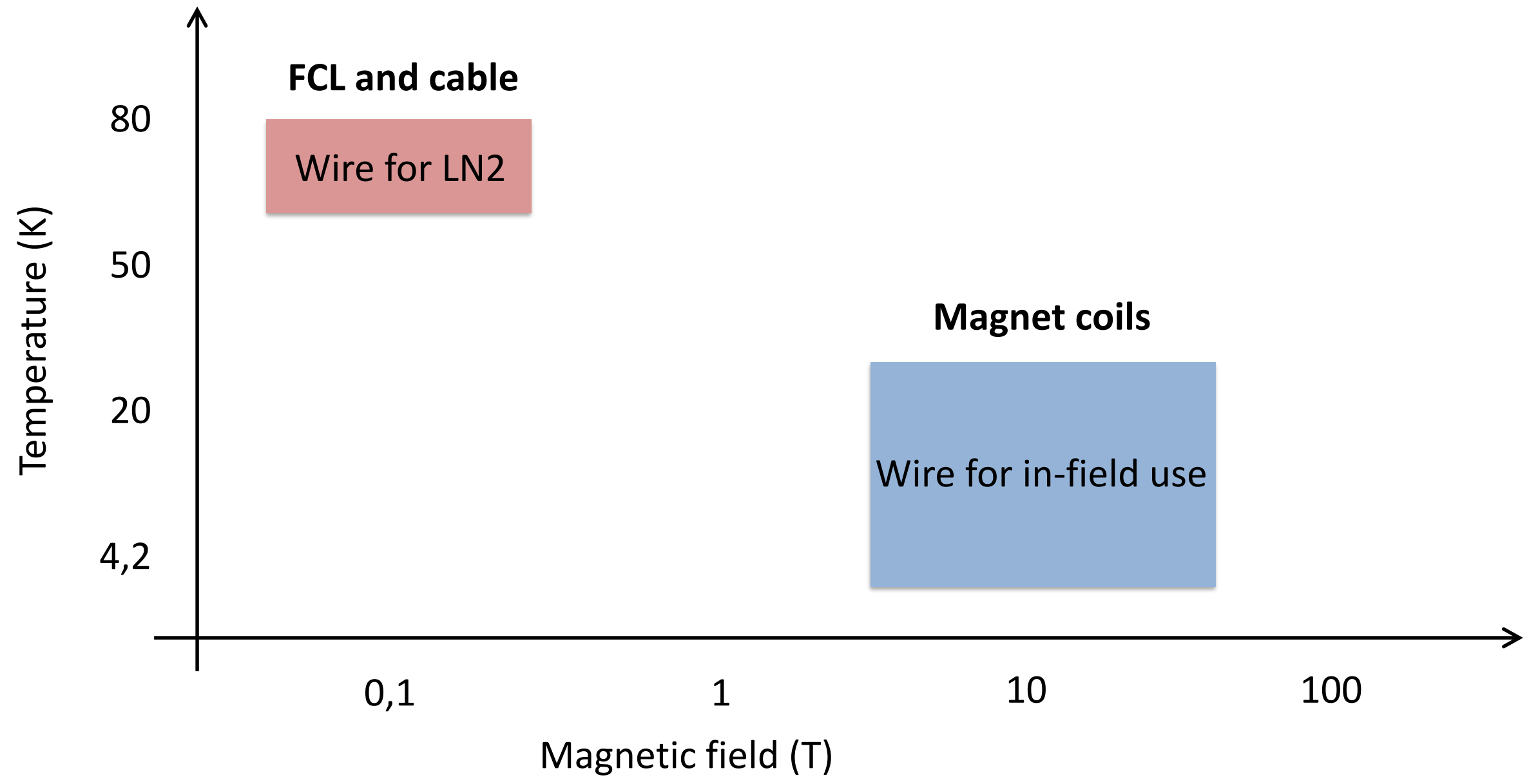
$J_e > 500 \text{ A/mm}^2$ at 77 K, s.f.
 $J_e > 1000 \text{ A/mm}^2$ at 20 K, 20 T
 $J_e > 2000 \text{ A/mm}^2$ at 4.2 K, 20 T

SuperOx 2G HTS wire: Production capacity



Demand drives capacity scale-up

SuperOx 2G HTS wire: Intended applications



SuperOx 2G HTS wire: Specifications

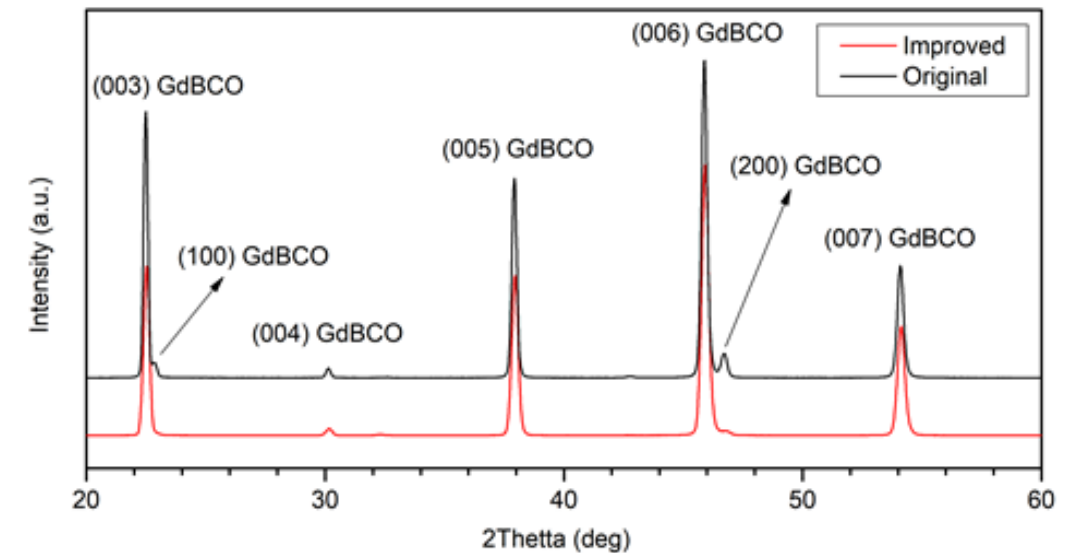
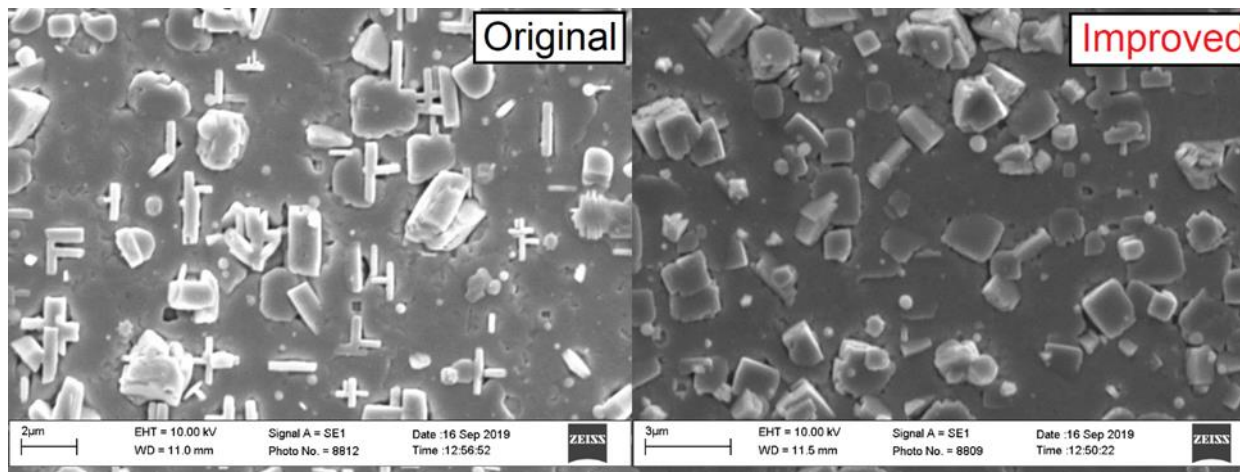
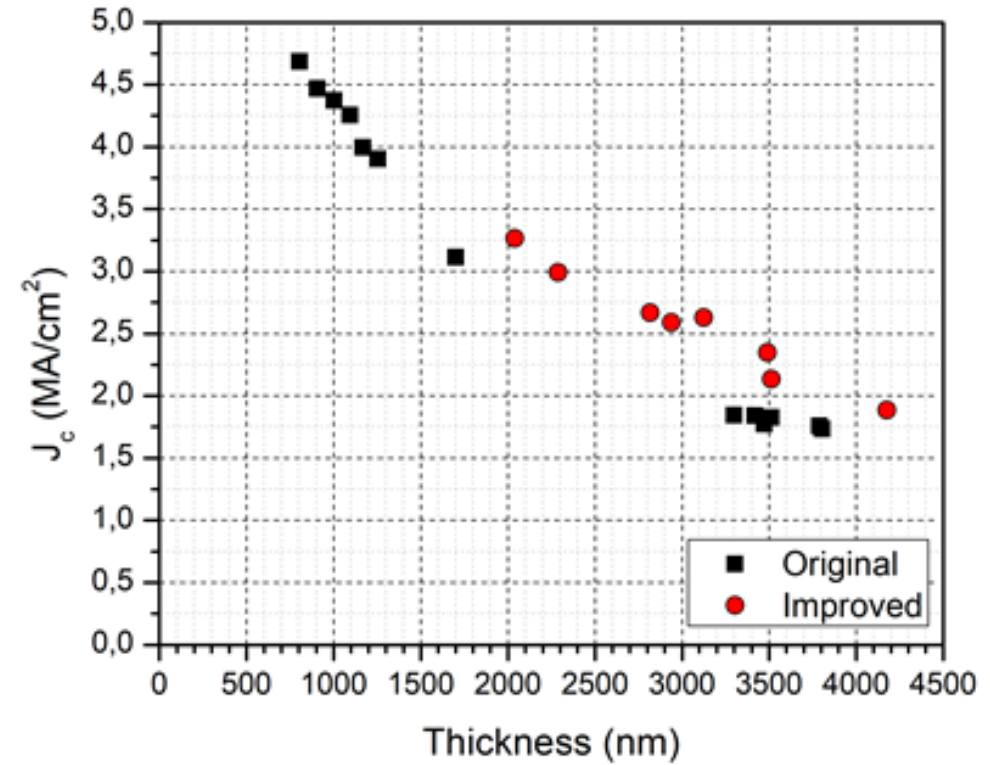
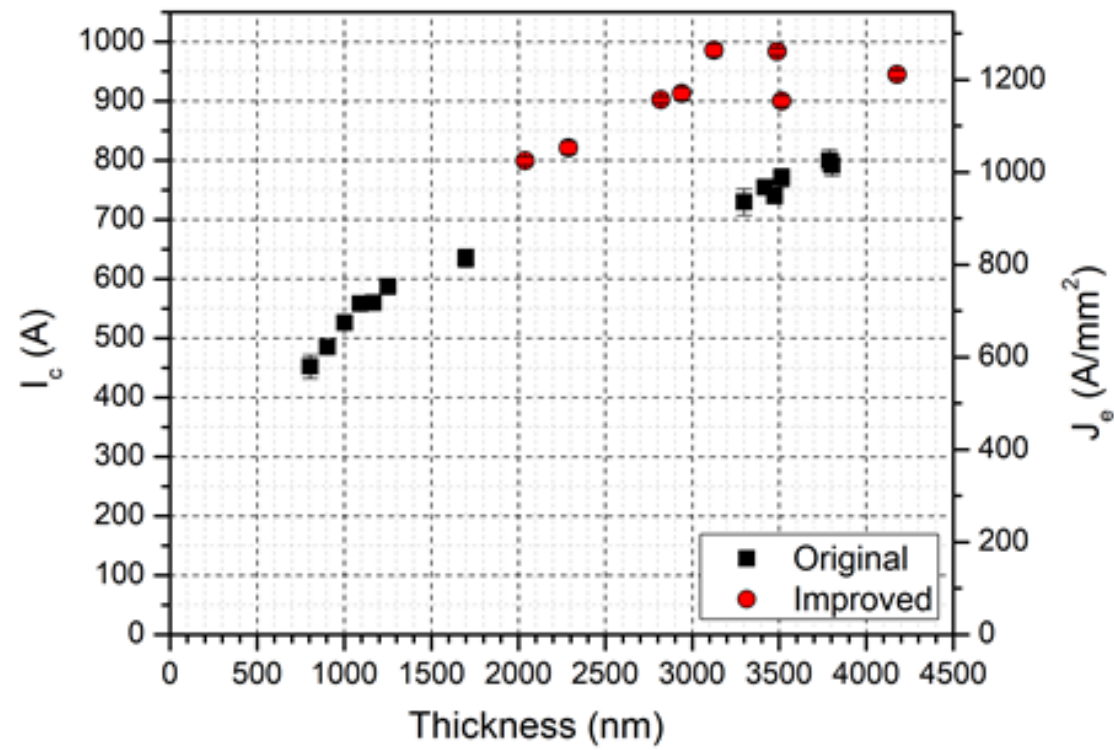


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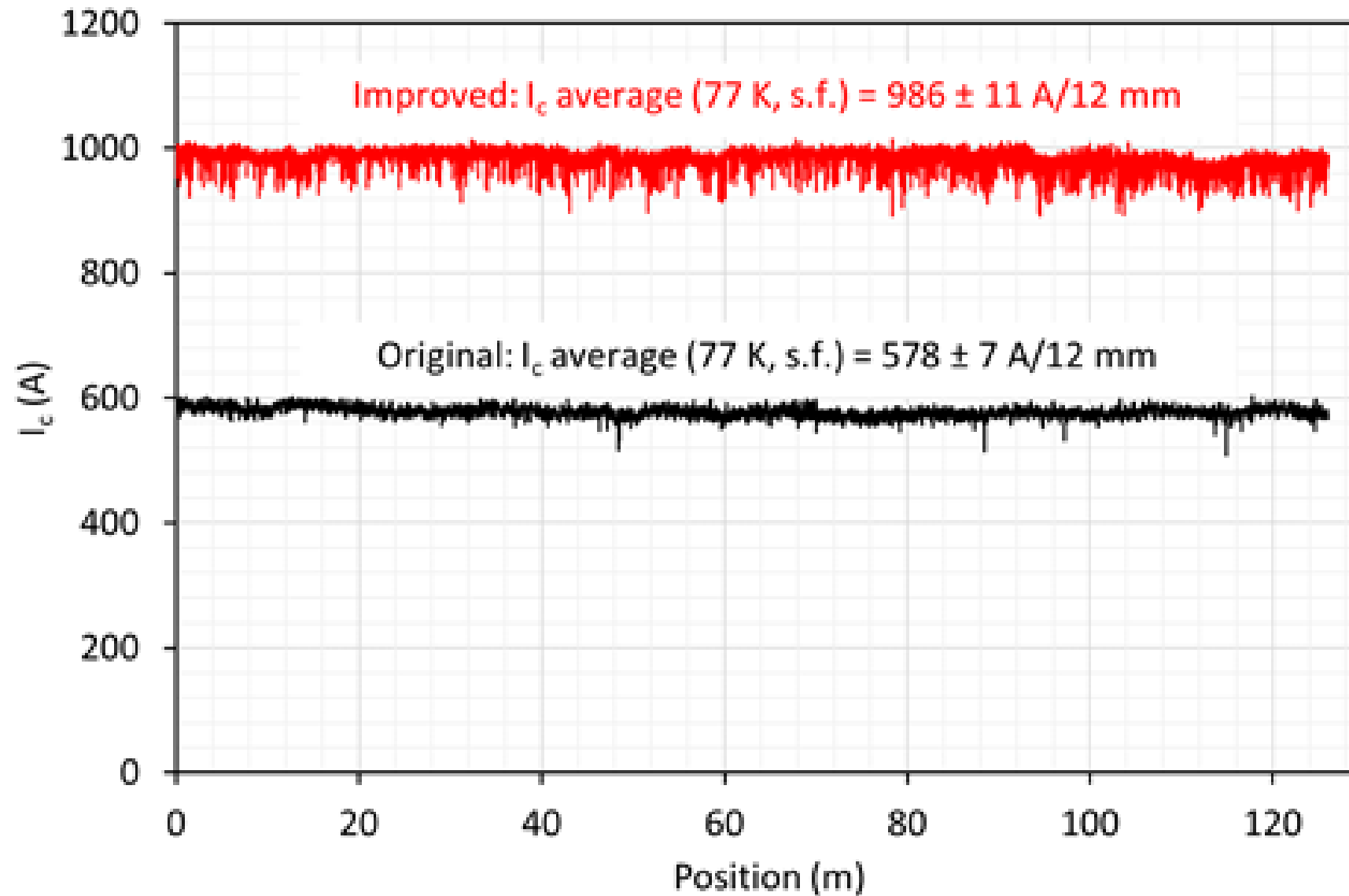
Customisation:

- + Variable copper thickness
- + Insulation: 10-20 μm thin polyimide varnish
- + Solder plating
- + Lamination
- + Low resistance splices
- + ... just ask

Wire for LN2, GdBCO: Increased I_c by thicker HTS layer



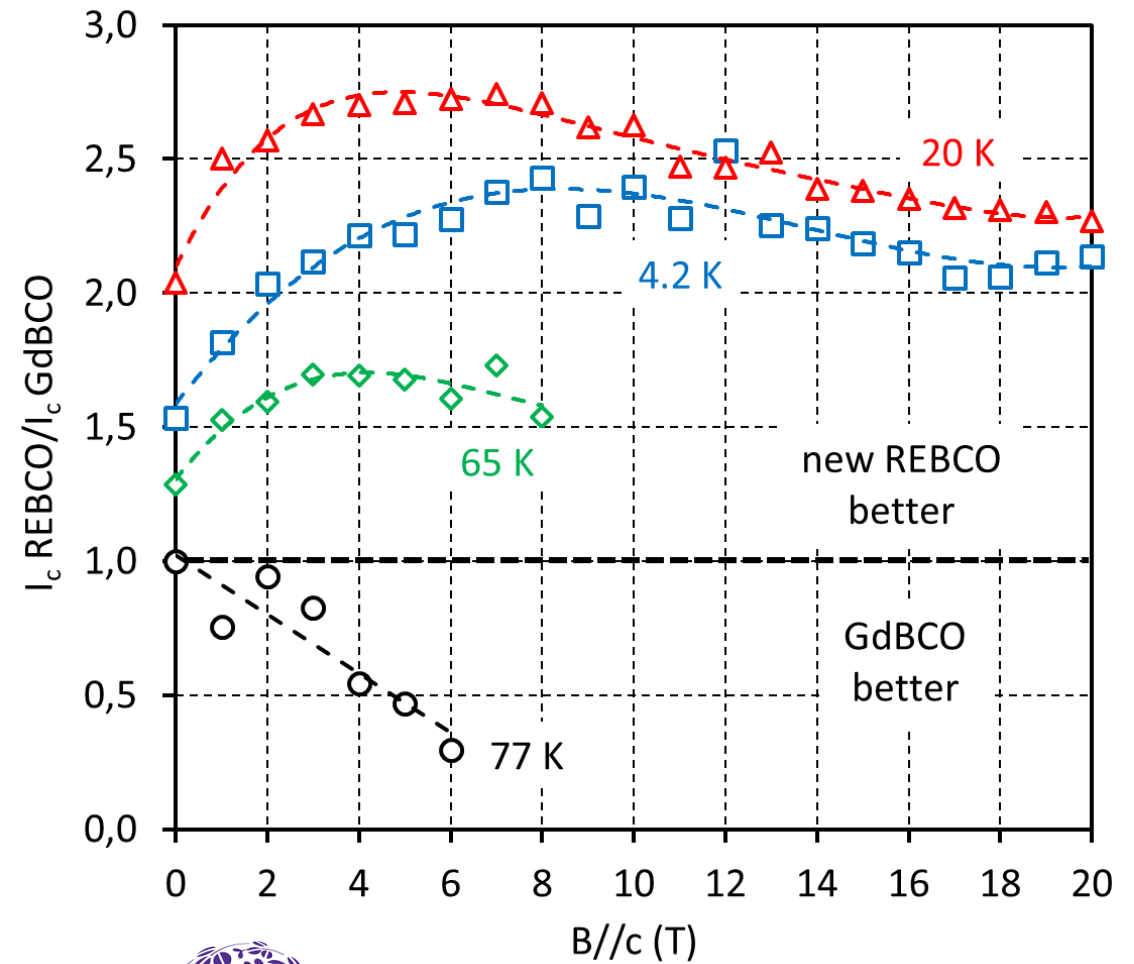
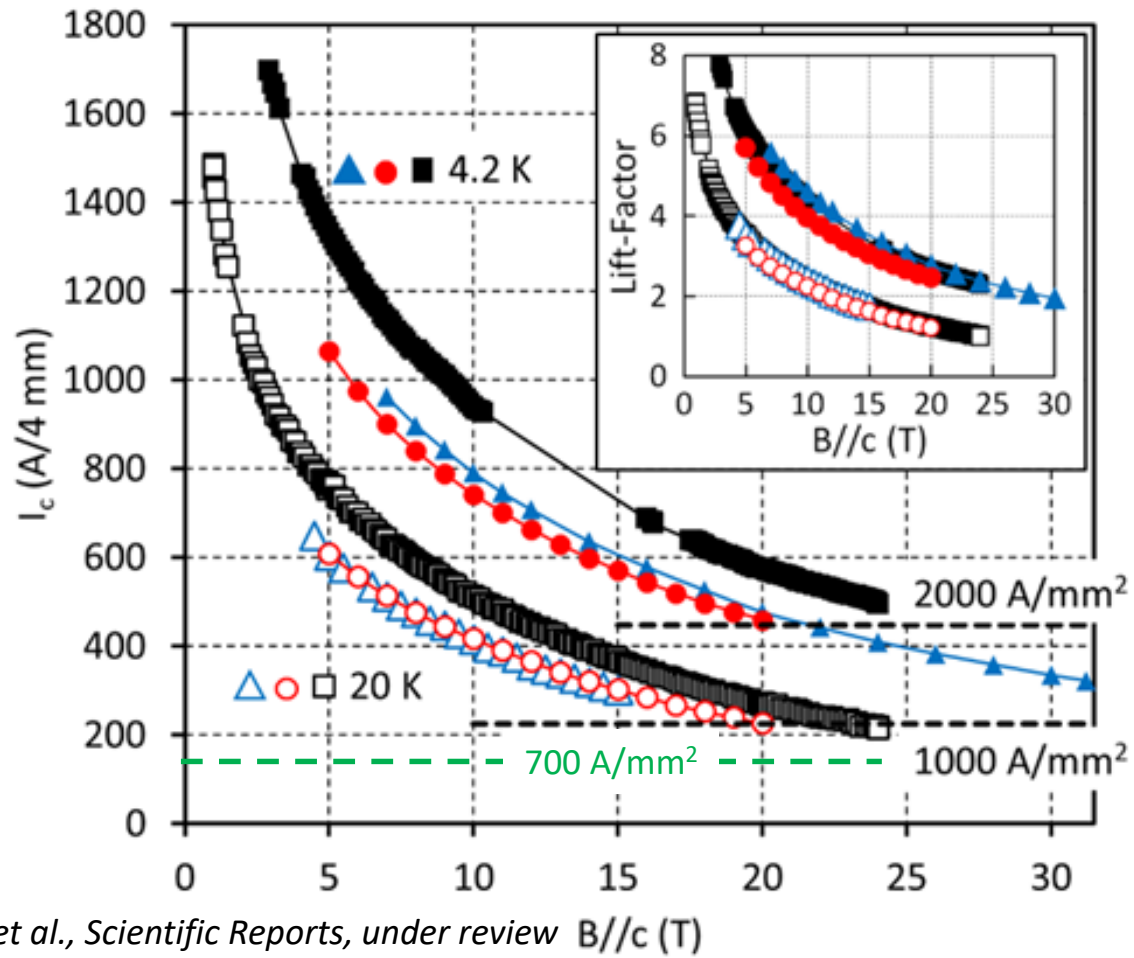
Wire for LN2: High I_c at 77 K, s.f.



New SuperOx wire for in-field use: Record I_c and J_e , REBCO + RE_2O_3

Wk1MOr2A-05

SuperOx



SuperOx



MIT
Massachusetts
Institute of
Technology



NATIONAL
MAGLAB



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S Innovations

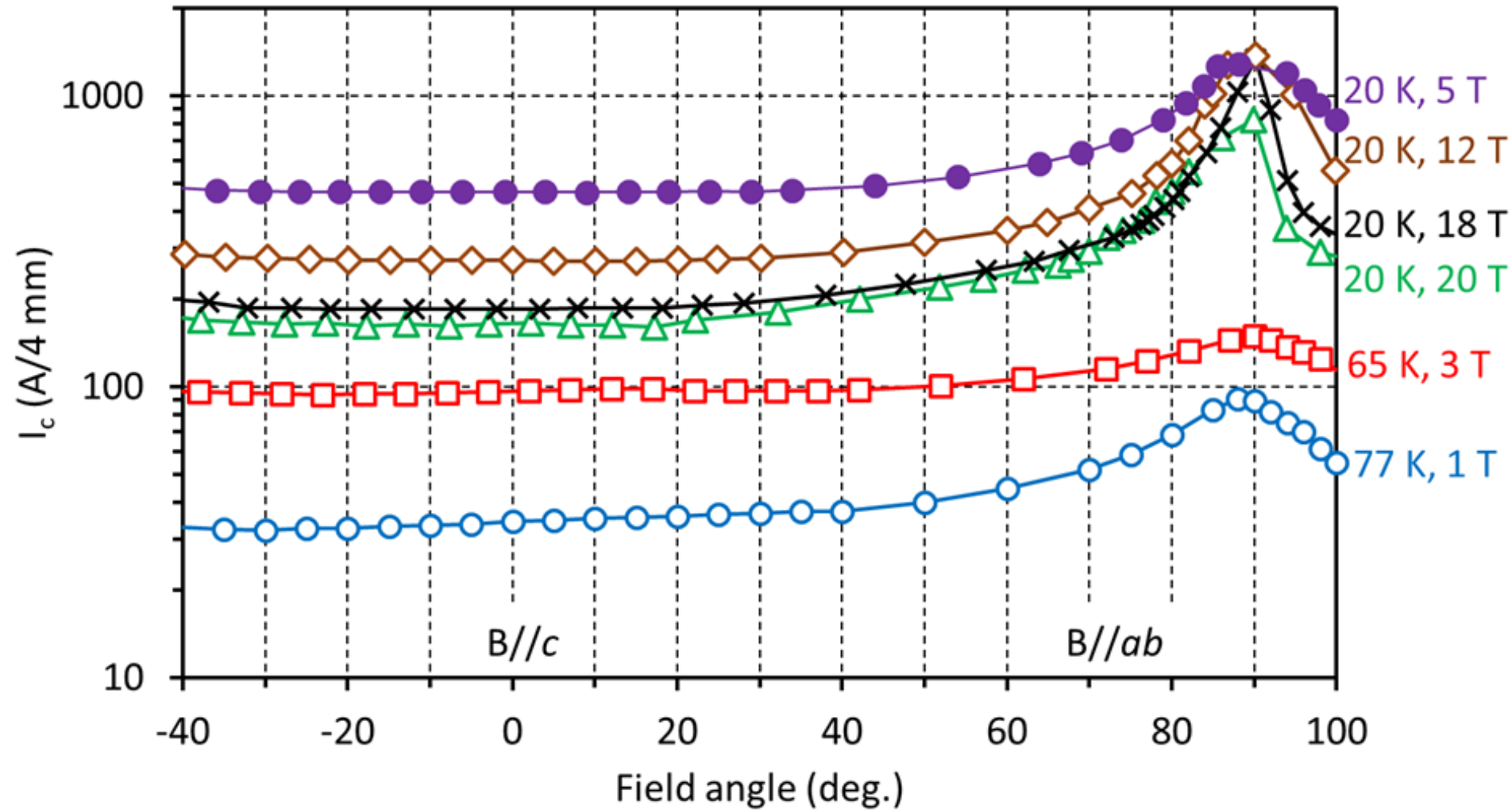
SUPEROX JAPAN



Robinson Research Institute

New: SuperOx wire for in-field use

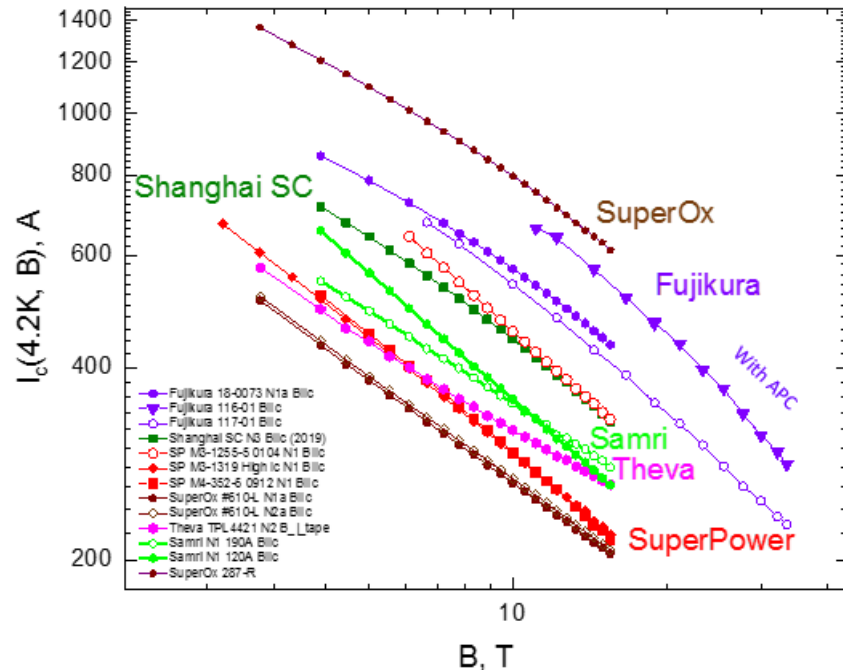
Minimum I_c is at $B//c$



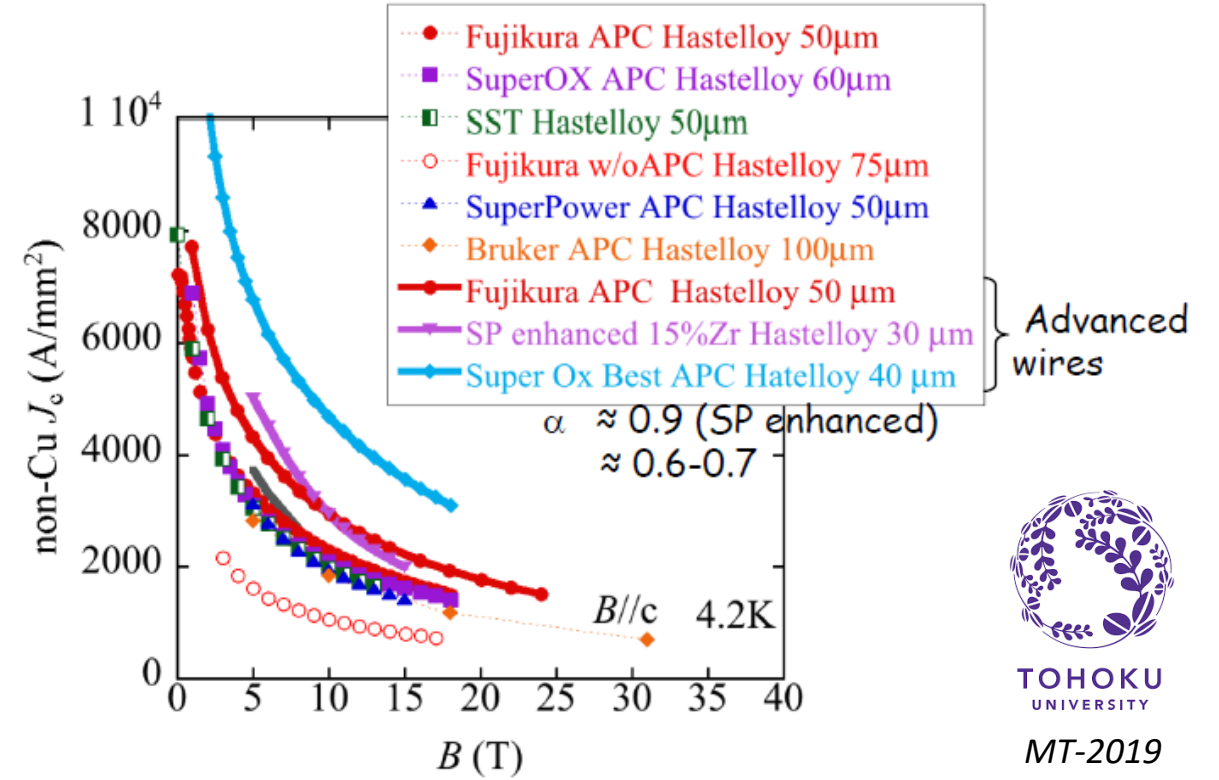
A. Molodyk et al., Scientific Reports, under review

- NO columnar APC
- Pinning by RE_2O_3 nanoparticles

SuperOx wire for in-field use: Best commercial wire for magnets today



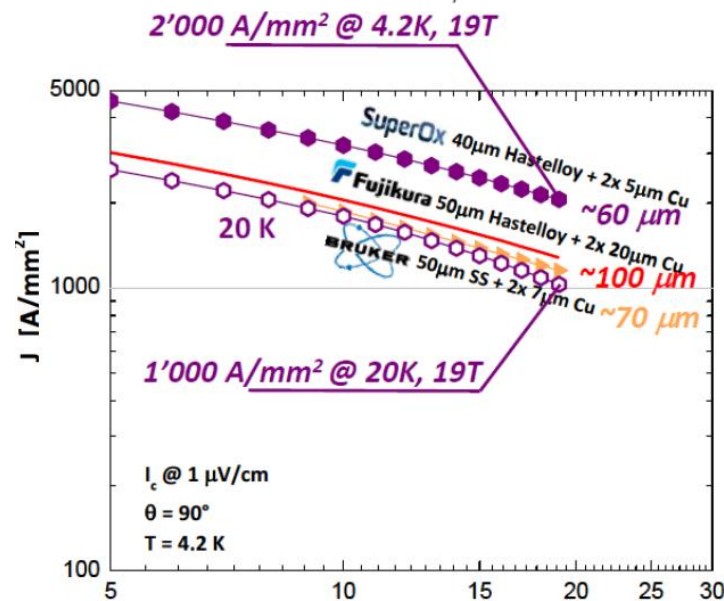
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MT-2019

I_c 30% higher than competition

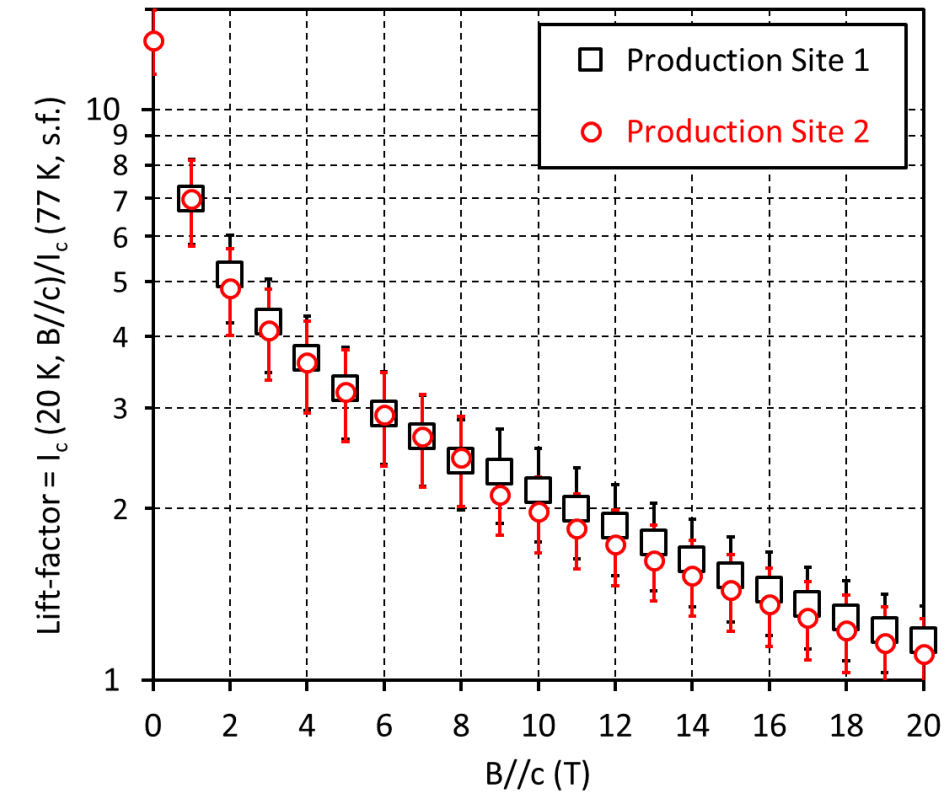
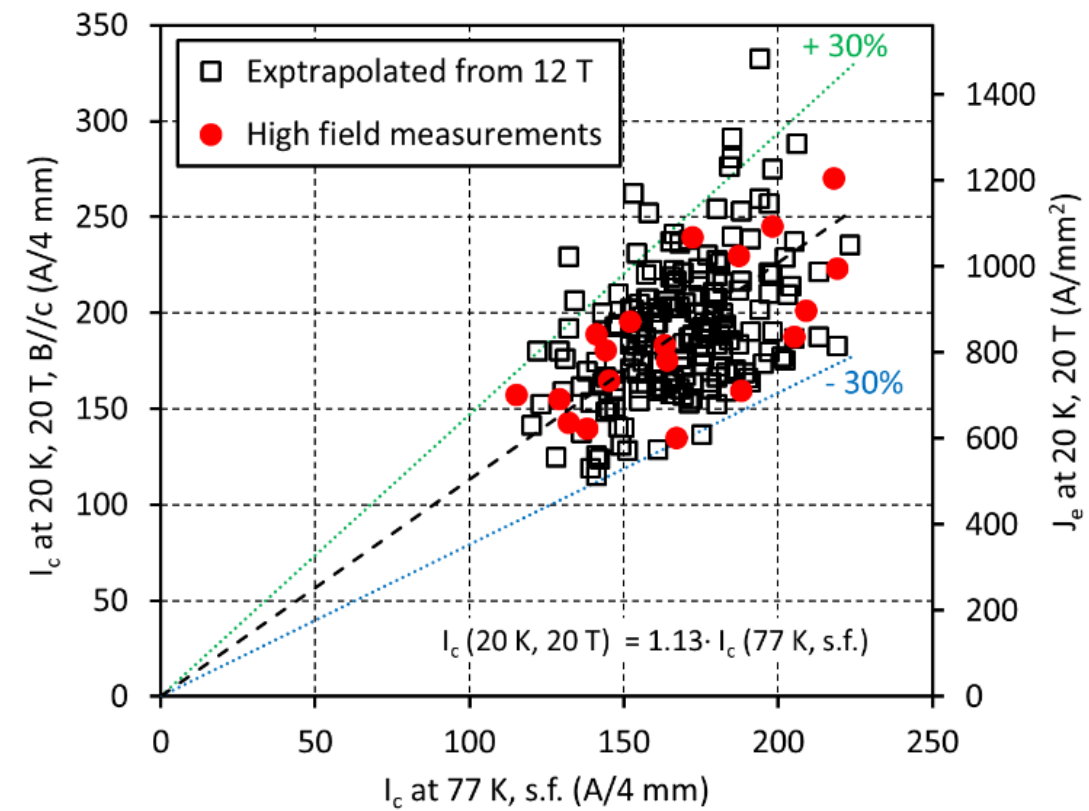


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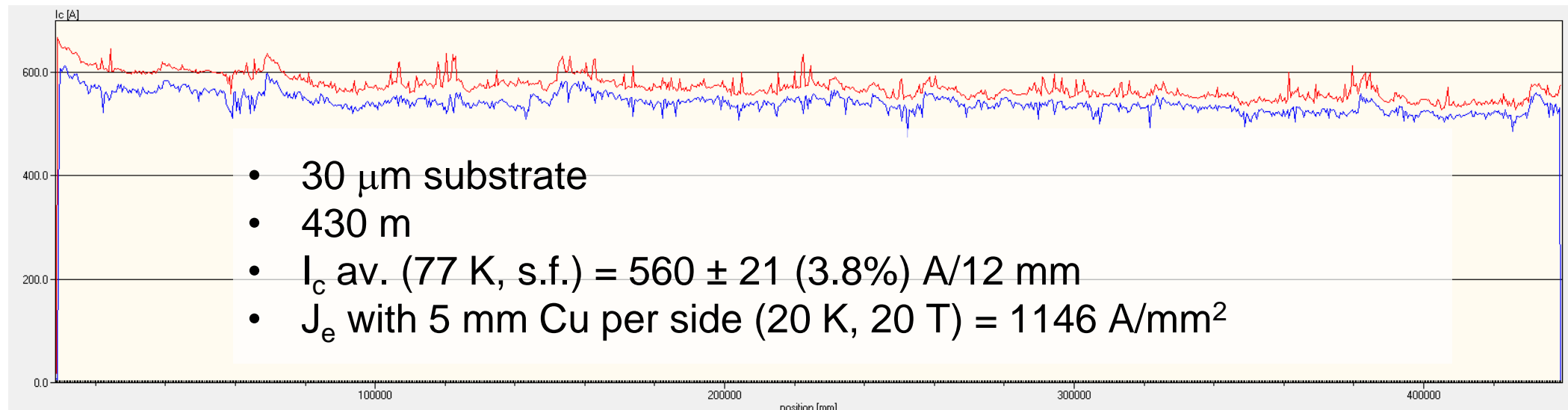
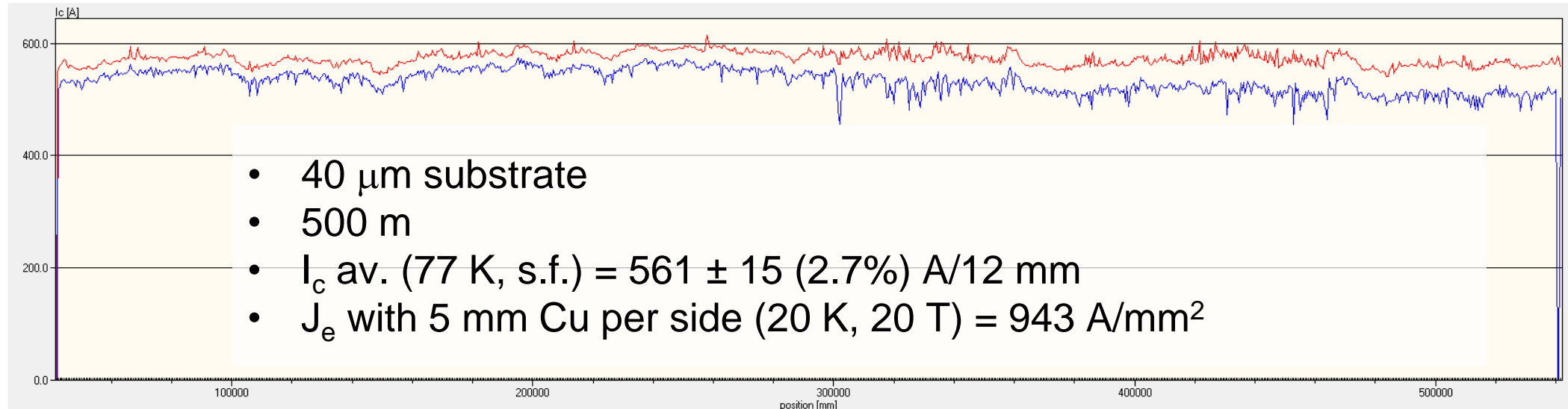
SuperOx wire for in-field use: 300+ km of 4 mm wire delivered to customers in 9 months



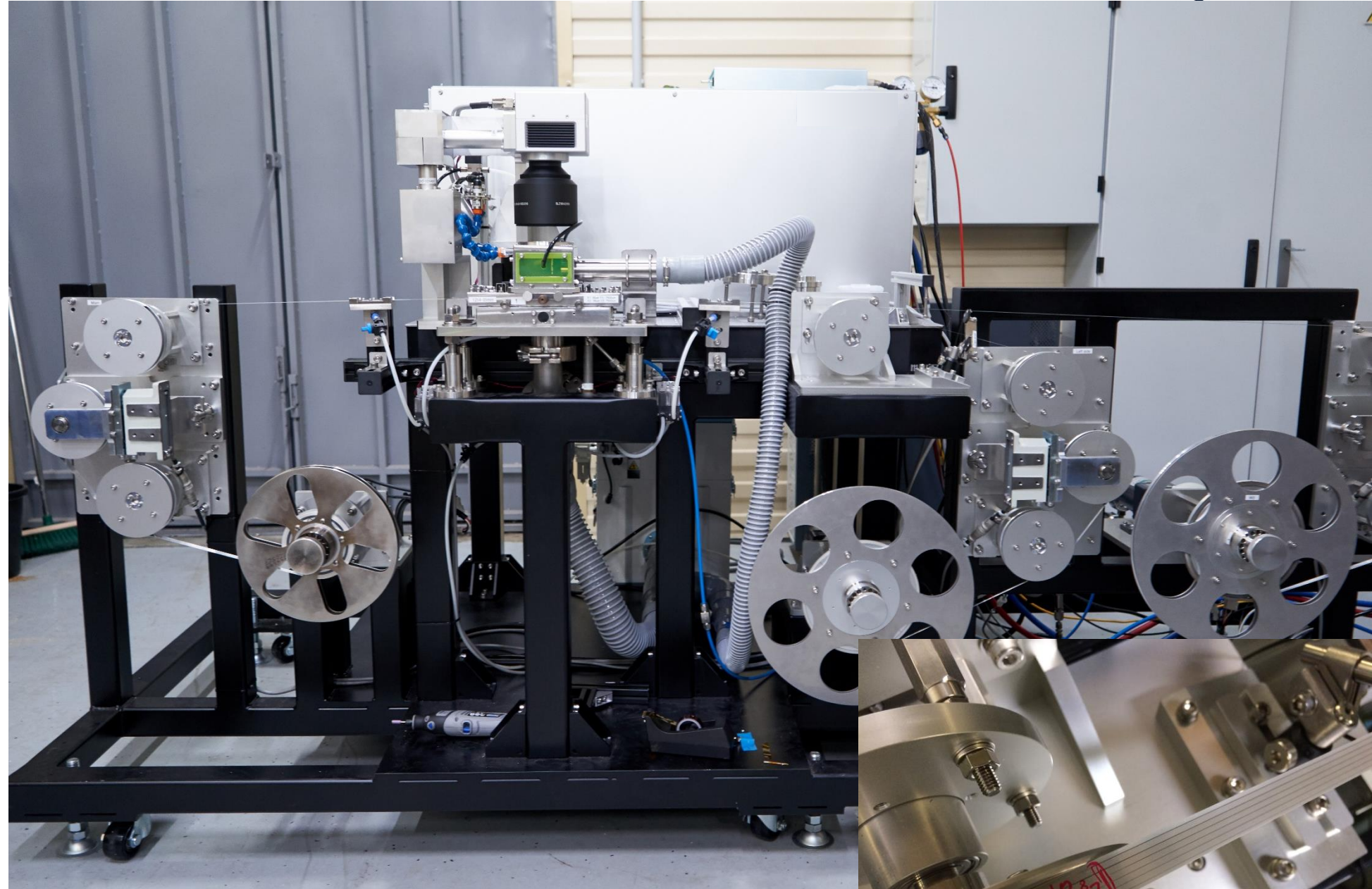
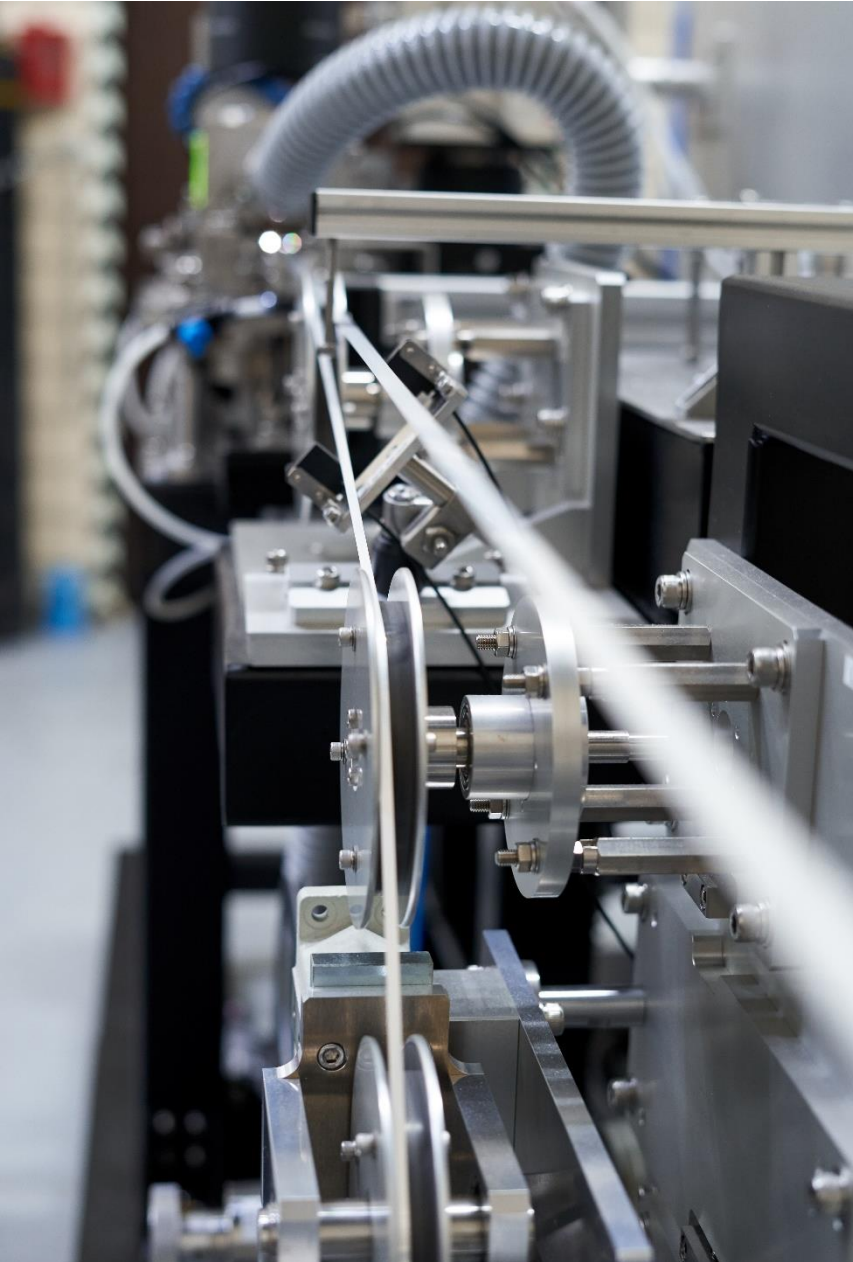
A. Molodyk et al., Scientific Reports, under review

- Reasonable statistical spread of in-field properties. StD ~ 15%
- Wires fabricated at S-Innovations and SuperOx Japan are identical

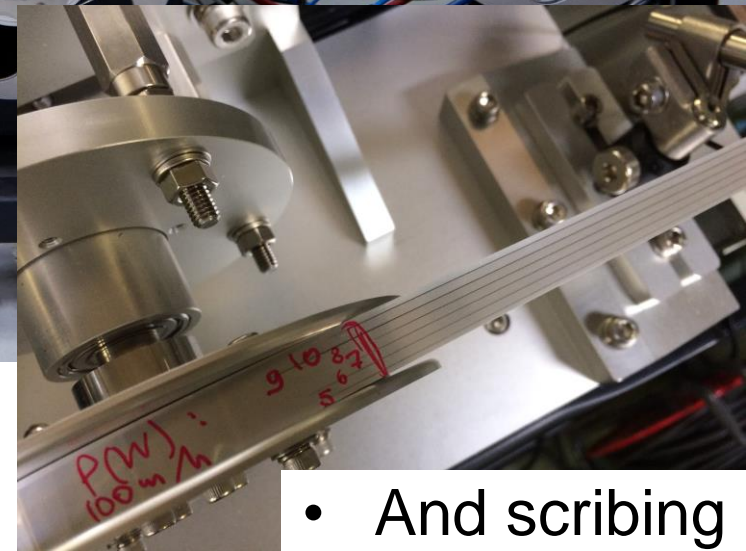
SuperOx wire for in-field use: 30-micron thick substrate gives more J_e



Same performance, +20% J_e with 5 μm Cu per side



- Slit edge is clean and free of cracks
- Less mechanical damage due to stress in applications



- And scribing

- The SuperOx group:
 - Produce and sell 2G HTS wire
 - Commercialise HTS applications
- Production technology and capacity:
 - Operate at 100%, scale-up to reflect demand
- Wire for LN2:
 - I_c up to 1000 A/12 mm with thick HTS
- Wire for in-field use:
 - Produced daily in large volumes
 - Record commercial J_e : 1000+ A/mm² at 20 K, 20 T; 2000+ A/mm² at 4.2 K, 20 T
 - 30-micron substrate adds another 20% to J_e
- Laser slitting:
 - Clean slit edge

Thank you for your attention