Renewable Energy

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Industry Applications

Energizing Superconductors

Distribution Grids

Cost-effective production of HTS wires by chemical solution deposition

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CSD processing

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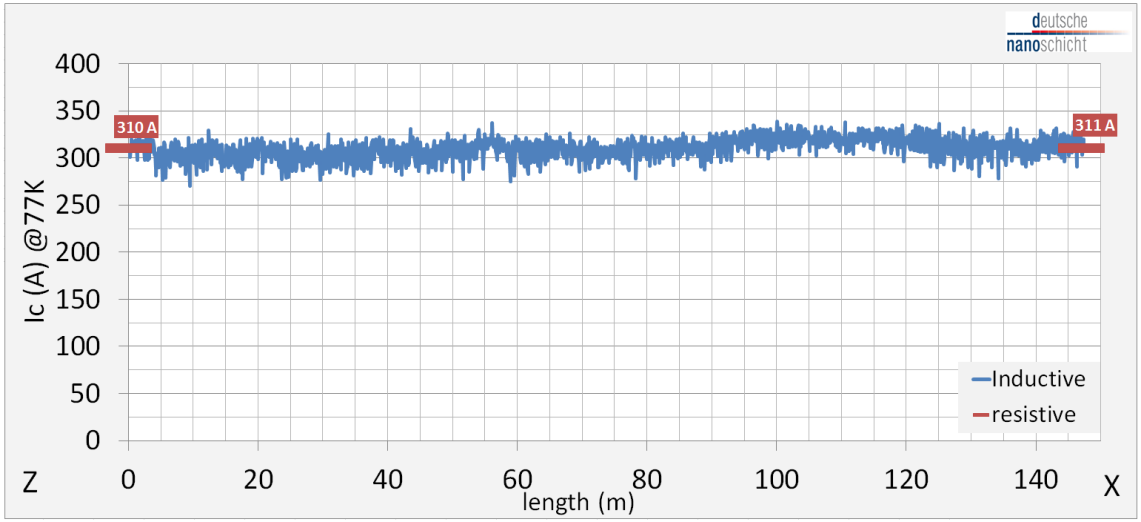
- Chemical solution deposition for complete layer architecture
  - Best price performance ratio for large volume production
  - Unique and protected technology

Content

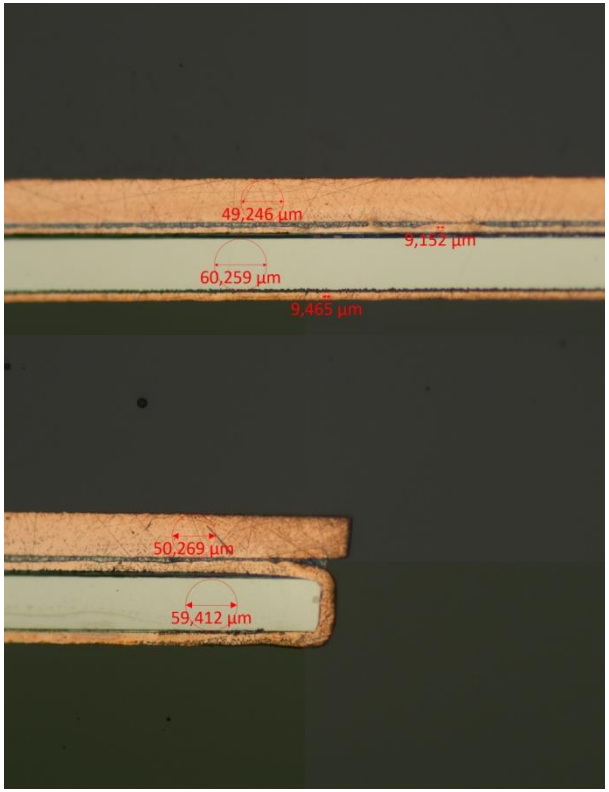
- Industrial applications
  - DC bus bars
    - Long length laminates
    - Performance at low fields and high temperatures
    - Production upscaling
  - Magnets
    - Performance at medium fields and low temperatures
    - Joint technology
    - Mechanical performance: bending
- Distribution grids
  - AC cables
    - Non-magnetic substrates
    - Mechanical requirements: strain and twist

Industrial applications
DC bus bars

- single copper laminate - HTS neutral fiber
  - Long length with high homogeneity
  - Mechanical and electrical stability with high J_e



150m x 10mm, 310±10A (@77K,sf), homogeneity <5%



50µm single copper laminate

Industrial applications
DC bus bars

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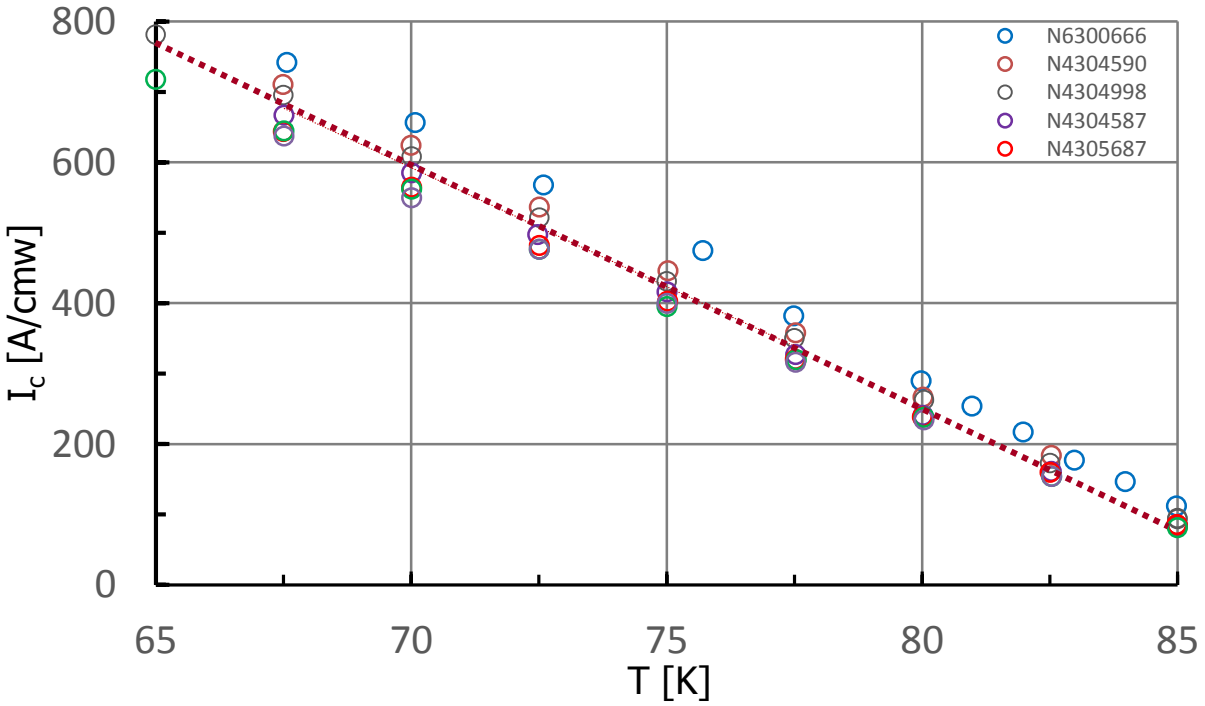
- single copper laminate - HTS neutral fiber
  - Performance at low fields and high temperatures



Best HTS tapes > 800A @65K,sf

I_c (B,°,T) system
(0-5T, 0-180°,
0-800A, 20-100K)

Industrial applications
DC bus bars

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- single copper laminate - HTS neutral fiber
  - Upscaling: wide tapes and production devices

4x25m high temperature annealing furnace

40mm fully buffered tape

Industrial applications
Magnets

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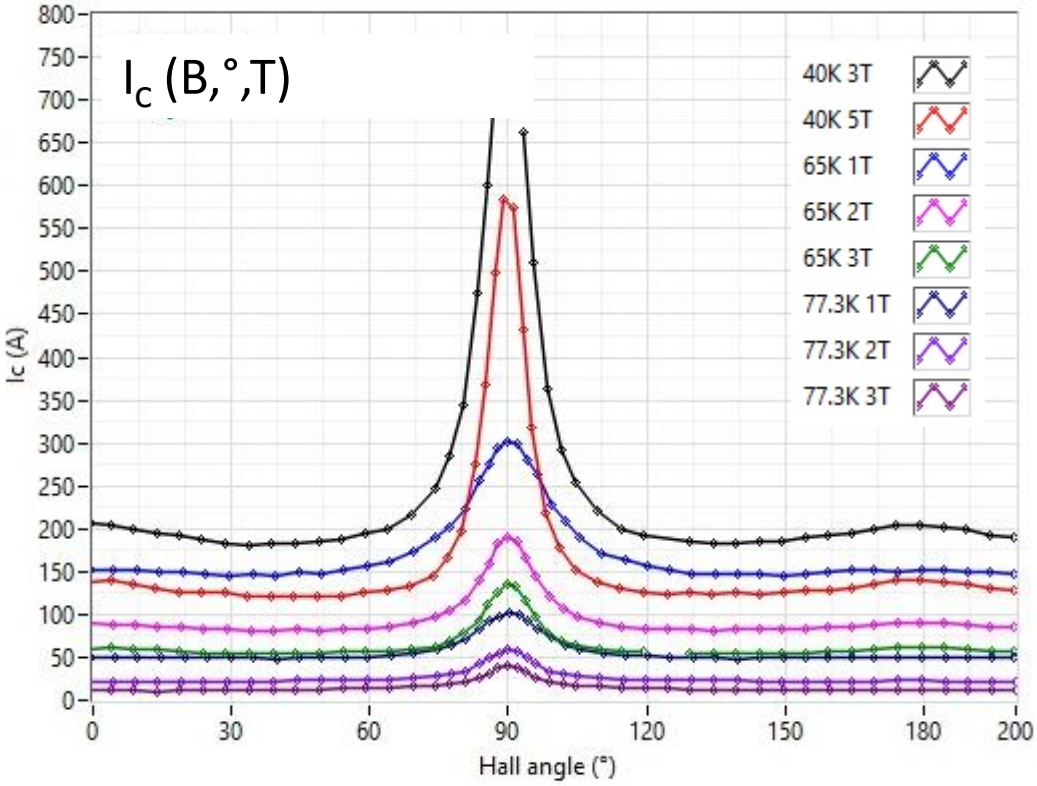
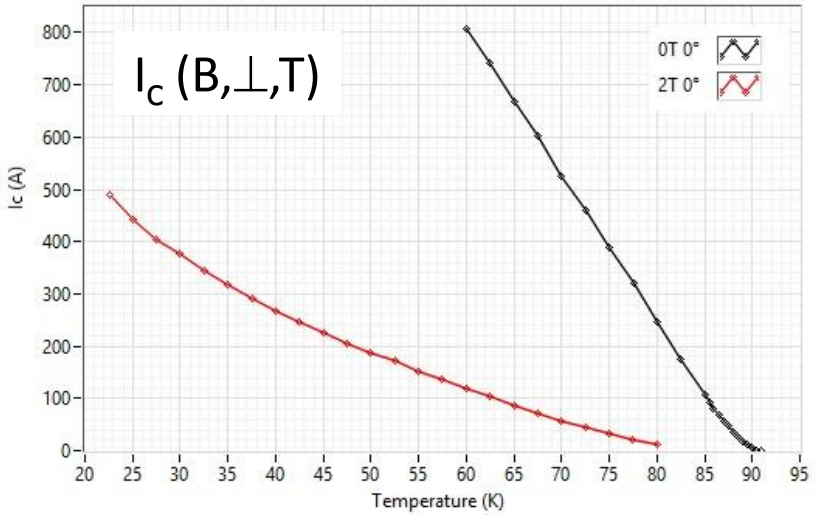
- Performance at low temperatures and medium magnetic fields
  - Typical operation conditions: 30-50K, 1-3T





Typical I_c(B,T) behaviour

Industrial applications
Magnets

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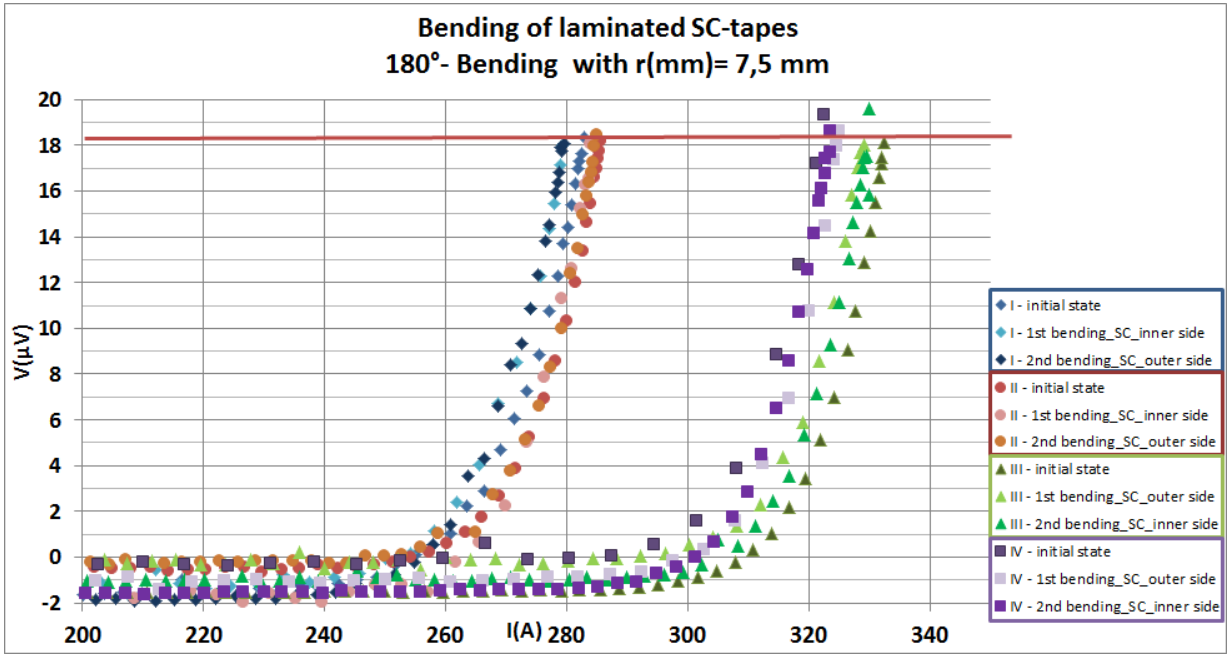
- Customized laminates
  - Small bending diameter possible



I_c degradation <2% for double bending on 15mm diameter

Industrial applications
Magnets

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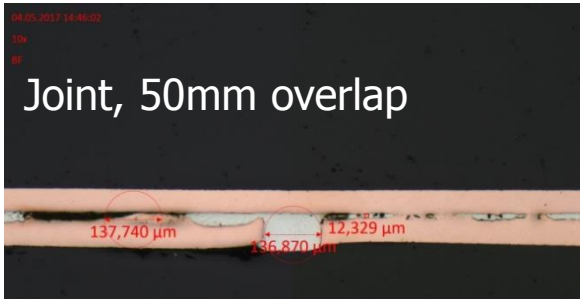
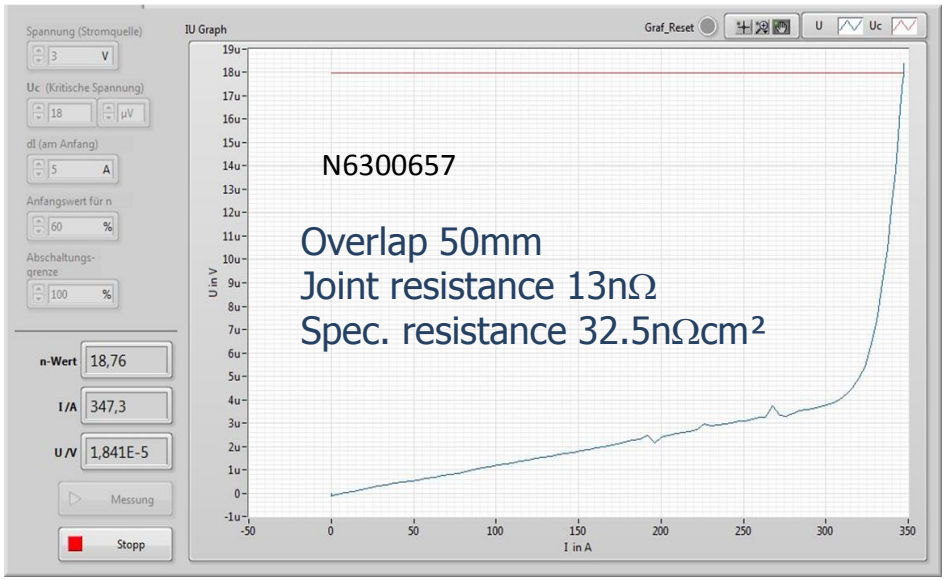
- Joints and splices
  - Bridge-type joints
  - Lead free solder paste (mp >200°C)



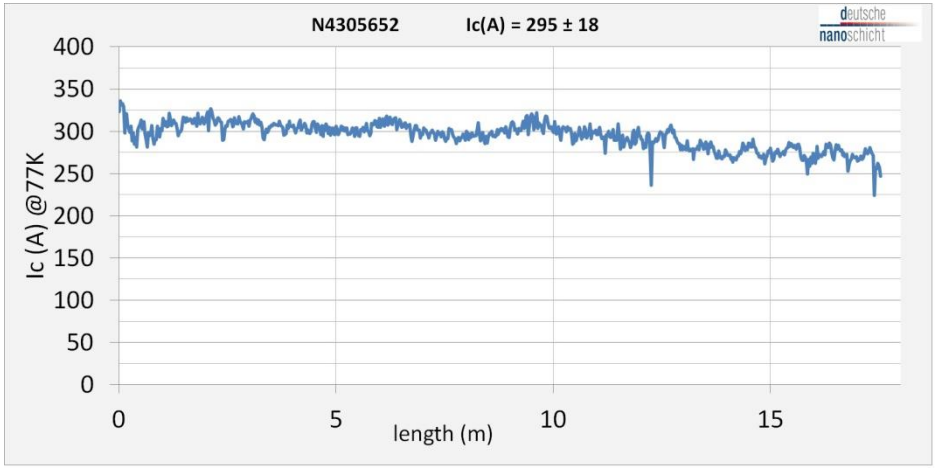


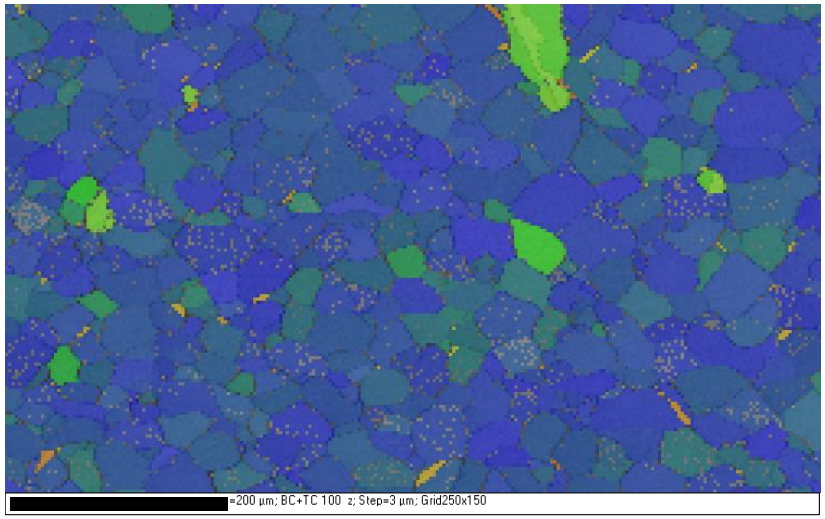
Typical joint resistance <20nΩ

Device for joints and splices

Grid applications
AC cables

- Non-magnetic substrates
  - <100m processing in R&D
  - I_c (@Ni9W) ≈ I_c (@Ni5W)





EBSD: 93,4% index rate, 94% in 10° tilt

I_c: 308A/cmw

Grid applications
AC cables

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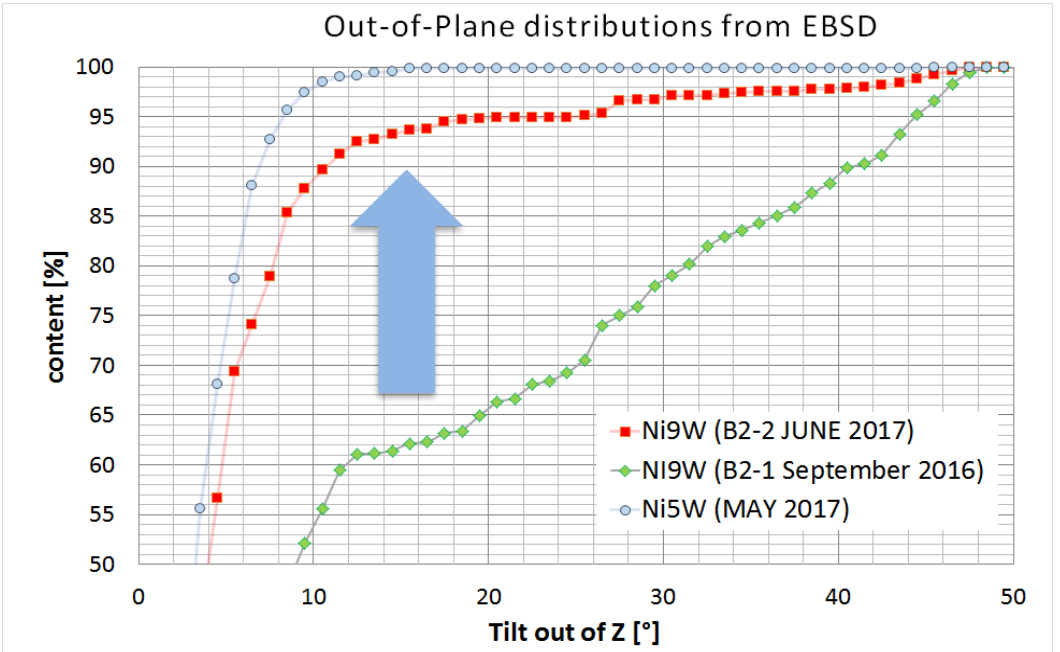
- Non-magnetic substrates
  - Improvements in large scale processing

~10 t ingot processed to 60 µ tape



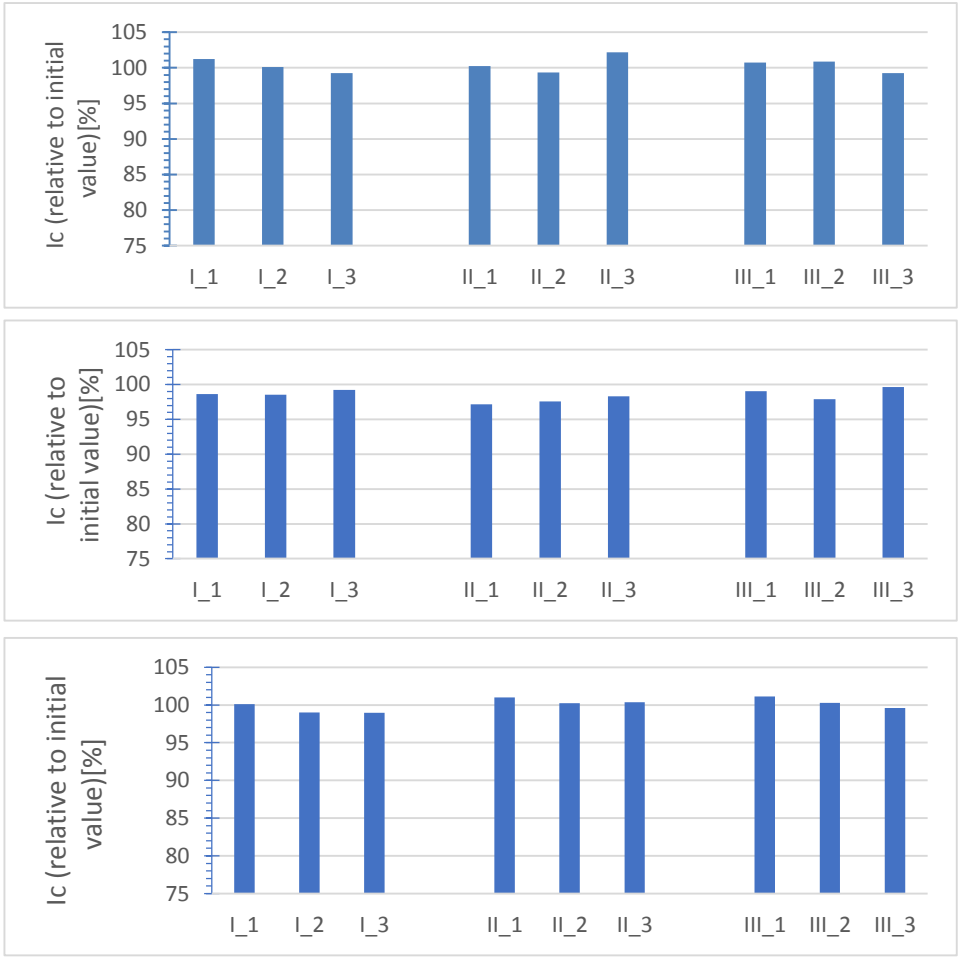
Tape	% Cube	Error	% Cb-G	Error
Ni5W (MAY 2017)	99.9	0.1	0.0	0.0
Ni9W (B2-2 JUNE 2017)	93.7	0.8	3.0	0.6
NI9W (B2-1 September 2016)	62.2	1.6	15.8	1.2

Preference in cube growth >90%

Grid applications
AC cables

- Mechanical requirements
  - Tensile stress: 250mPa
  - Twist: 200mm, 360°
  - Bending: ∅ 30mm

3 batches of 10mm wide HTS tape



HTS tapes fullfill typical requirements for AC cable applications

Summary

- Up-scaling of production ongoing
  - 40mm technology partially implemented
- HTS tapes customized for applications availiable
  - Laminates, joints
- Mechanical and electrical specifications reached
  - Bending, twist, strain, resistance, I_c (B,°,T)
- In-house test facilities qualified
  - 5T-I_c-tester, mechanical testing

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Energizing Superconductors

Thanks for your attention