Karlsruhe Institute of Technology

Institute for Technical Physics

Development of small diameter HTS Cross Conductors for Fusion Magnet Application

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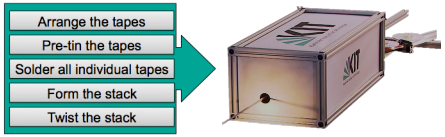
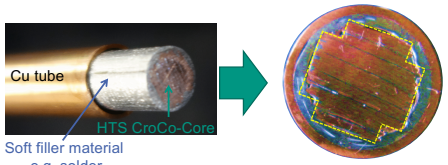
Economic long length production

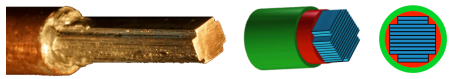
Production of HTS CroCo core with 3 m/min



Jacketing with outer seamless Cu tube

HTS CroCo core + filler + outer Cu tube ➔ HTS CroCo





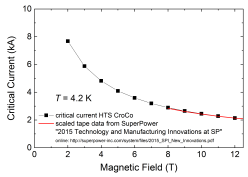
Current transfer to the complete soldered stack

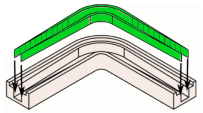
Soldered stacks of REBCO tapes with thick Cu envelop
and/or intermediate Cu tapes
to allow current transfer from the sides and from tape to tape

HTS CroCo: Easy connectable / Different sizes

HTS CroCo – no sc degradation during fabrication and easy connectable

Formation and twisting of HTS CroCo is performed in liquid solder,
➔ no degradation compared to pure REBCO tape





Connecting 2 HTS CroCos with additional REBCO inlays
➔ 38 nΩ contact resistance only (60mm contact length)
with no "special preparation" of HTS CroCo ends!

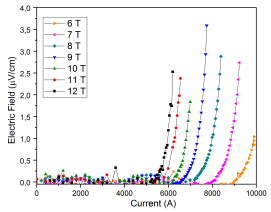
HTS CroCo – available in different sizes

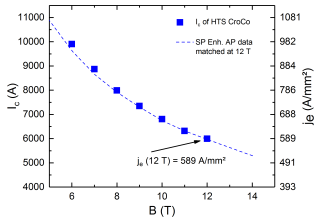
Diameter of HTS CroCos can be adapted to fit the application

	6/4 CroCo	4/2 CroCo	3/2 CroCo
Number of *RE*BCO tapes	22 x 6 mm 10 x 4 mm	18 x 4 mm 18 x 2 mm	18 x 3 mm 10 x 2 mm
Ø incl. tube	9.3 mm	6.7 mm	5.8 mm
I_c (4.2 K, 12 T)	> 10000 A	~ 8000 A	6000 A
I_c (4.2 K, s.f.)	~ 35 kA	~ 20 kA	~ 15 kA
I_c (77 K, s.f.)	3160 A	~ 2000 A	1460 A
Min. bending radius R_{min}	< 60 cm	< 40 cm	< 30 cm

Example of 3/2mm HTS CroCo

consisting of 10 x 2 mm SCS 2050AP +
18x3mm tape SCS 3050-AP measured in FBI





References
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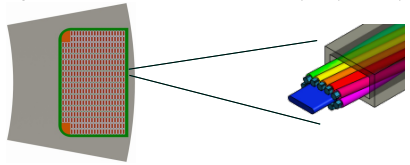
M. J. Wolf *et al.*, IEEE TAS **26** (2) (2016), 6400106
M. J. Wolf *et al.*, IEEE TAS **26** (4) (2016), 4801504
W. H. Fietz *et al.*, IEEE TAS **26** (4) (2016), 4800705
R. Heller *et al.*, IEEE TAS **26** (4) (2016), 4201105

HTS CroCo – Application

Large high-field magnets e.g. fusion magnets

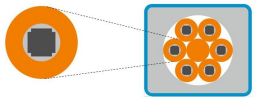
First design approach was a compact Rutherford cable for a DEMO TF coil
with I_c(4.5 K, 13 T) = 50 kA resulting in a temperature margin of 11 K.

SPC built and tested a similar cable successfully up to 60 kA at 12 T
(D Uglietti et al., Supercond. Sci. Technol. 28 (2015) 124005)

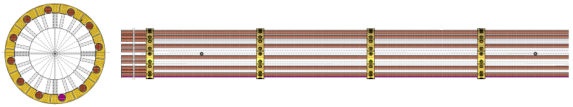


Next KIT approach for fusion magnet conductors

will be based on concentric HTS CroCos around a central copper core



In parallel KIT targets a 35 kA HTS CroCo high current cable (DC) based on 6/4 mm HTS CroCo



Conclusion

HTS CroCo is a superconductor base element

- **with simple long length manufacturing incl. twist**
- **„all-in-one" fabrication of core (3 m/min)**
- **no degradation caused by fabrication**
- **good mechanical and electrical stabilization**
- **easy connectable with additional REBCO inlays**
- **adaptable in size and I_c to requirements of the application**