Low temperature bonding of superconducting tapes covered by Ag layer

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Introduction

- Investigation of the possibilities to bond two tapes together to produce a single conductor with a higher critical current
- HTS tapes (THEVA) with Ag layers on Ag cap layer
- Bonding achieved by applying pressures on tapes where the joint is foreseen:
  - Etched only
  - Etched and covered by Ag powder

Tape with clean Ag surface (a) and etched surface (b)

- Etching over vapours of H$_2$SO$_4$
- Temperature of the vapours 94°C
- Room conditions during the pressure treatment

Etched sample only
- Etched sample with Ag powder on surface
- EDS analysis of sample in cross section
- Pressure at the start of process 7MPa
- Face to face images of place where the joint is delaminated
- All layers of tapes are visible
- Strong bonding of surfaces treated 120s

Etched sample with Ag powder on surface
- EDS analysis of sample in cross section
- Grain size of powder 2μm-40μm
- Pressure at the start of process 7MPa

Measuring of joint resistance by impulse at 77K
- Soldered contact on SC side of tape
- Contact resistance around 2nΩ

Measuring of Ic at 77K
- Soldered contact on Cu surface added on the ends of double tape

Contact resistance

\[ R = 3.1 \times 10^{-4} \] with a correlation coefficient of 0.9259

2Ag + 2H$_2$SO$_4$ → Ag$_2$SO$_4$ + SO$_2$ + 2H$_2$O

XPS analysis
- Reaction of acid with surfaces of tapes forms the silver sulfate

XPS sample under EDS analysis of the sample

Conclusion

- Possibility of low temperature (at around 100°C) joints without additional material
- Non-destructive influence of process for transport Ic
- Perspective bonding of HTS tapes by diffusion
- Optimisation of parameters (time, pressure)

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Contact resistance

Critical Current

- Magnetic measurement of Ic at 77K
- Brandt model
- Magnetic measurement: Ic (double tape) around 900A

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