Influence of architecture of composite superconducting tape-based stacks on AC demagnetisation for electric machines application

Anis Smara, Nikolay Mineev, Vicente Climente-Alarcon, Lukasz Tomkow, Thomas Reis, Bartek A. Glowacki,

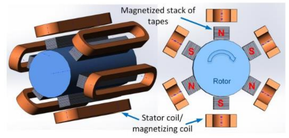
Introduction

Stack of superconductors

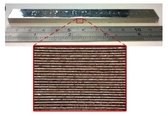
- Good thermal conductivity
- Good mechanical properties
- Variety of shapes, sizes and configurations

Trapped field record of 17.7 T in a stack of high temperature superconducting tape

Stack of superconductors as trapped field magnets in electrical motors



Self-Supporting Stacks



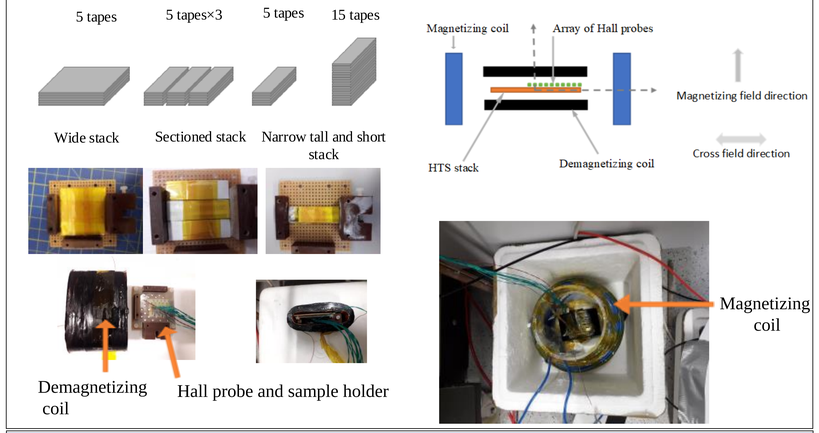
Advantages

- High trapped flux densities
- No current leads through a rotating interface

Main challenges

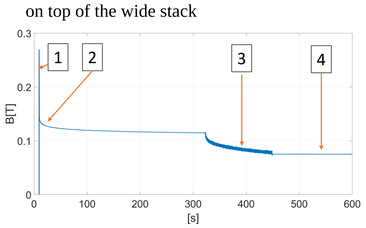
- Magnetization
- Demagnetization

Research Idea : Compare 4 HTS stack architectures in terms of magnetization and demagnetization



Elements of study

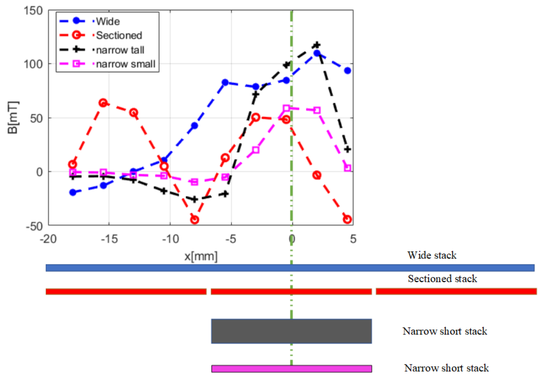
Example of hall probe measurements on top of the wide stack



Experiment steps

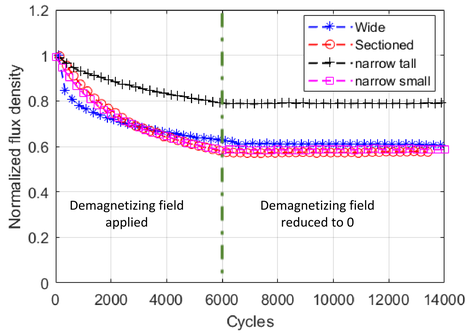
1. Pulse field magnetization (normal field)
2. Flux creep and normal trapped flux density
3. Demagnetization (cross field appllied0
4. Flux density after demagnetization

Magnetization measurements



- Wide stack traps a waveform with a positive peak
- Section stack traps a waveform with positive and negative peaks caused by the return of flux.
- Short narrow stack (5 tapes) has the lowest peak value of the flux density
- Tall narrow stack (15 tapes) has the highest peak value of the flux density

Demagnetization Comparison‘ Experimental’

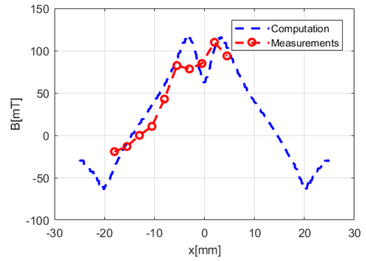


- Increasing the width of the stack reduces demagnetization
- Increasing the width from 12 mm to 40mm reduces the demagnetization by about 5%
- Increasing the number of tapes from 5 to 15 reduces the demagnetization by 20%

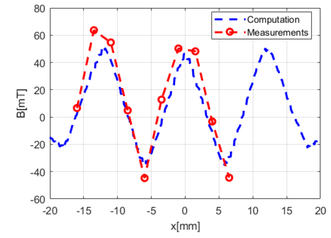
Modelling and experimental comparison for magetnization

Trapped flux density comparison

Wide stack

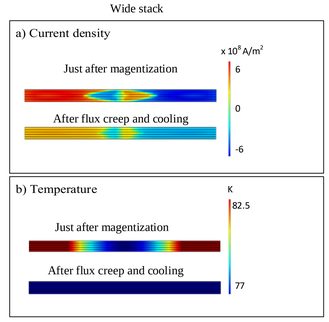


Sectioned stack



- Good agreement between Measurements and computations
- H- formulation

Wide stack



- Saturated stack with 4 current loops
- Temperature rises where the current first penetrates

Conclusion

- AC cross field causes demagnetization of Trapped field magnets
- Reduction of demagnetization by increasing the number of tapes is more efficient than by increasing the width of the tape
- Sectioned stack has a comparable demanganization rate as the wide stack

Acknowledgement

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