Karlsruhe Institute of Technology

1MP7-17

EUCAS 2017

Institute for Technical Physics
Superconducting Materials and
Applications in Energy Technology
P.O. Box 3640
D-76021 Karlsruhe, Germany
rainer.nast@kit.edu

Development of a reel-to-reel process for laser structuring of coated conductors

R. Nast, A. Kario, B. Ringsdorf, W. Goldacker

1. Introduction

- High current carrying capacity of coated conductors (CC) favourable for power applications and high field magnets
- AC magnetization losses are remarkable due to the coated conductor architecture and their high aspect ratio
- Striations significantly reducing the magnetization losses
- For applications as coils or cables, long length are required
- Striations on long length conductors need to be demonstrated

2. Experimental

In former investigations we demonstrated up to 120 filaments in 12 mm wide tapes. To extend this process for long lengths we installed a reel-to-reel system in our picosecond laser machine reaching a comparable precision of the pattern of ±5 µm. This is realized by a step and repeat process in which the tape feed (step width 5 cm) is done by a linear table and supervised by a CCD-camera. In this work we showed the first 5 m long striated 12 mm wide Ag-cap SuperPower tape with 10 filaments.

Fig. 1 Reel-to-reel system

3. Results

I. Striations/homogeneity

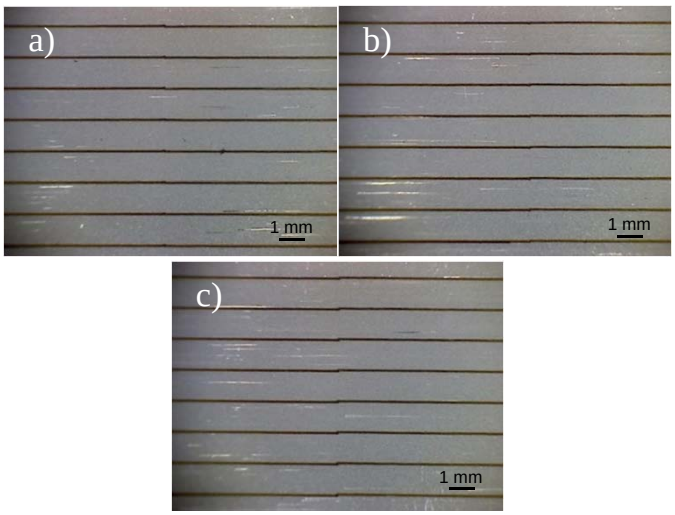

Fig. 2 Top views of striated Ag-cap tapes (10 fil.), a) first 170 cm of tape, overlapping of grooves nearly perfect, b) second 160 cm of tape, very good overlapping c) third 170 cm of tape, 30 µm displacement of the grooves

- 5 m of a SP Ag-cap conductor was striated
- During striation process, unexpected shut down appeared
- After shut down and restart a displacement of the laser grooves of about 30 µm was found, fig. 2 c)
- During continuous operation laser grooves are aligned, a), b)

II. Transverse resistance

- Transverse res. was measured on chosen parts of the tape
- 15 cm long pieces with 3 sectors from aligned and misaligned region were cut out
- Voltage across the samples was measured in order to prove homogeneity of the laser grooves

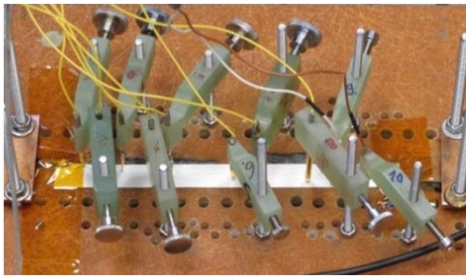

Fig. 3 Measurement set up of transverse resistance

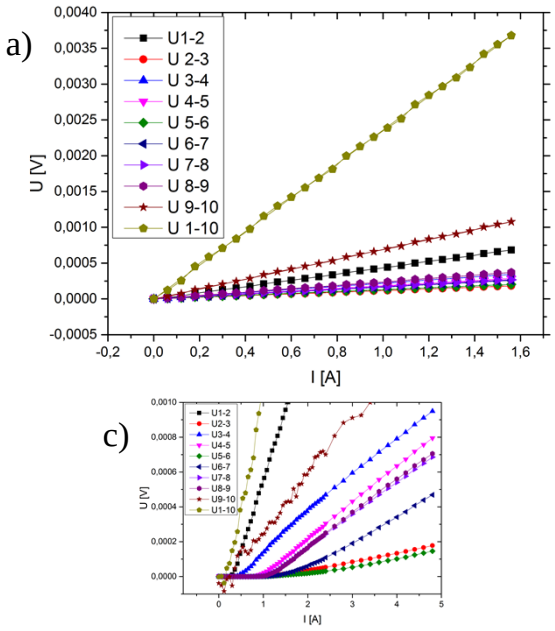

Fig. 4 U-I curves of a) the areas with nearly perfect overlapping of the grooves and c) with about 30 µm displacement

For the areas with groove overlapping the U-I curves show resistive behavior, a). With a displacement of 30 µm the U-I curves show at the beginning superconducting signals, indicating superconducting bridges between the filaments, c).

4. Summary

A 5 m long Ag-cap tape from SuperPower were structured with an Nd:YAG Pico-second laser system using a reel-to-reel process.

- Continuous operation of the system result in aligned resistive grooves
- Unexpected shut-down lead to misalignment of laser grooves and superconducting bridges between the filaments
- System need to be upgraded to be able to align the sample again precisely, when unexpected shut down appear