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Wed-Mo-Or12-03: Design, construction and test of thermally activated ReBCO switches

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Aiming to demonstrate the feasibility of a 10-kA class all-ReBCO based superconducting rectifier of the transformer-type, the development of high current ReBCO switches is crucial. A group of four switches in a bridge arrangement called switch-bridge has been developed. The switches are based on cyclic thermal heating of stacks of ReBCO tapes, operating in the 50 to 60 K temperature range when switched 'on' (no heating applied) and above 90 K when switched 'off'. Thermal and electromagnetic models were generated for optimizing the total number of tapes and heating power required to turn 'off' 2 out of 4 switches of the selected bridge layout. For manufacturing this configuration of the switch, in total 36 SuperOx tapes of 12 mm width have been etched over an 8 mm-long central section using an 'in-house' etching method and recipe developed. Details of the etching process and key manufacturing steps are reported. The complete switch-bridge assembly, fully suitable and compliant for a rectifier circuit, has been tested in standalone mode in a liquid nitrogen bath. The test results including critical current of the switch gates, 'off'-state resistance and switching time constants between 'on' and 'off' states are presented. The results are used to extrapolate the performance of the switch bridge towards the target operating conditions. With the results obtained, the proposed design of the switch is experimentally verified, and its application in combination with a transformer in a superconducting rectifier circuit is further discussed.

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