HIGH-CURRENT HTS CABLES FOR FUSION MAGNETS

S.I. Schlachter, W.H. Fietz, W. Goldacker, F. Grilli, R. Heller, A. Kudymow

Karlsruhe Institute of Technology, Institute for Technical Physics, Karlsruhe, Germany

Corresponding author: sonja.schlachter@kit.edu

For fusion reactors beyond ITER, e.g. DEMO, an HTS solution for the magnet system would bring many advantages. The use of high-temperature superconductors (HTS) for the magnet system would allow to run the magnets at elevated temperatures. A magnet temperature around or above 65 K would save cooling costs due to the much higher Carnot efficiency. Rough estimations result in savings of electrical cooling power of approximately 40%. Furthermore, the complex thermal shield could be omitted which would reduce the size and complexity of the cryostat.

Due to the excellent magnetic field dependence the most promising HTS material for fusion coils is the RE-Ba-Cu-O Coated Conductor (REBCO-CC, RE = Rare Earth). It is the only technical superconductor which can be applied at fields beyond 10 T at temperatures above 50 K. The availability and performance of this material has steadily improved in the last years. Worldwide many prototypes of cables, fault current limiters, magnets or rotating machinery are realized currently. For fusion magnets, however, the requirements are completely different from those of most other applications. Fusion magnets require conductors with current carrying capabilities above 20 kA, low ac losses and good electrical and mechanical stability. In contrast to low temperature superconductors like NbTi and Nb_3Sn which can easily be produced in quadratic or round geometry, the flat coated conductor tapes cannot be cabled with a simple bundling technique due to the bad bending properties in tape plane direction. In the past years KIT showed that the ROEBEL technique is promising for production of coated conductor cables with reduced ac losses. Demonstrator cables were realized with current carrying capabilities up to 2.6 kA (77 K, self field). However, for current carrying capabilities > 10 kA in fields of several Tesla a simple scale-up with additional tapes is not possible. We present a concept for Coated Conductor Rutherford Cables (CCRCs) for currents exceeding 10 kA using Roebel cables as strands (Fig. 1). First results for the superconducting properties of a subsize CCRC with 10 strands consisting of 4 mm wide Roebel cables will be shown.

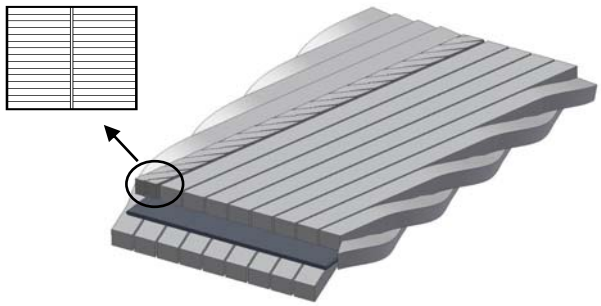

Figure 1: Concept of Coated Conductor Rutherford Cable (CCRC)