Contribution ID: **255** Type: **Poster presentation (105min)**

High-Temperature Superconducting (HTS) Coils for a Compact Spherical Tokamak

Thursday, 10 July 2014 10:30 (2h 15m)

High temperature superconductors (HTS) have the potential to impact the future development of superconducting applications for research magnets in physical sciences and industrial products. A promising technique to obtain energy from fusion is reliant on high magnetic fields to confine the hot plasma during the fusion reaction. To generate these high magnetic fields very high currents are required which can be obtained by using superconducting magnets. We are constructing the world's first Tokamak using coils made entirely form 2nd generation YBCO tapes. The Tokamak has 6 D-shaped toroidal field coils, and two cylindrical poloidal field coils which will be operated at temperatures between 20K and 50K, well above the operating temperature of conventional LTS superconducting magnets.
The use of the HTS tape brings new challenges due to their brittle nature and sensitivity to mechanical stresses. We adapted the formation of the joints for the Tokamak construction and the joints showed low resistive dissipation. Results will be presented on the development of a process for metallic joints without the use of flux or external heaters. One of the advantages of this technique is that the joints can be formed in- situ in complex assemblies whilst minimising thermal stress and oxidization of the joint surfaces. The results reported include both lap joints between HTS tape / HTS tape and also joints between HTS-tape and copper terminals.

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Session Classification: Thu-Mo-Posters Session 3.4

Track Classification: C-08: Fusion magnets and conductors