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High Temperature Superconductors for Future Fusion Magnets and Industrial High Current Applications

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High-temperature superconductors (HTS) have the potential to enable the operation of a future fusion reactor at higher magnetic fields (> 14 T) or at higher temperatures compared to conventional low-temperature superconductors. In particular, the operation at high magnetic fields with good temperature margin is perceived to be an important advantage of HTS in a fusion power plant.

Fusion magnets require high current superconductors, which are embedded in a stainless-steel jacket for mechanical support against Lorentz forces and actively cooled by a forced flow of coolant. Design challenges and cable proposals for winding packs based on HTS conductors will be presented.

HTS CrossConductor (HTS CroCo) is a high current HTS conductor with high current density to be fabricated in long lengths. The recent progress of HTS CroCo fabrication will be shown and a toroidal field coil winding pack design based on such HTS CroCos will be presented as an example to demonstrate the principle feasibility of HTS for future fusion magnets.

The knowledge gained in the design of high-current conductors for fusion magnets and the experience to fabricate HTS CroCo strands in different geometries enable the design and construction of HTS DC cables for industrial high current applications as well. Key design aspects and promising fields of applications of HTS high current cables beyond fusion magnets will be presented.

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