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Performance of compact wind-and-react MgB_2 solenoid coil made with continuously produced cable

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MgB_2 superconducting wires hold the advantage over traditional NbTi wires of higher temperature operation, at lower cost than REBCO tapes, and allowing the use of existing winding techniques. The adoption of MgB_2 wires into large-scale applications such as MRI solenoid magnets, long-length power cables, wind turbine generators or industrial magnets requires a robust production process yielding long length wires with consistent performance. Bekaert and Epoch wires have developed a scalable powder-in-tube technique capable of producing MgB_2 wires in km lengths.

Achieving performance close to short sample in a solenoid coil is an essential step towards larger demonstration assemblies and coils, in wind-and-react or react-and-wind configurations. Here, we report on the performance of a compact wind-and-react solenoid coil wound from Bekaert/Epoch wires 1+6 MgB_2 cable. The filament diameter is 0.4 mm, the cable has a twist pitch of 26 mm and a Cu:SC ratio of 0.9. The coil is wound from 148 m of S-glass insulated cable in 6 layers, on a former with diameter 52 mm, and was reacted in a vacuum furnace. The coil was tested without epoxy impregnation.

The coil was tested in a He-vapor cooled VTI inside a 10 T Cryofree magnet, at 10 K and 20 K and at up to 4 T background field. The maximum current in the coil was 300 A at 10 K, generating a self-field of 1.47 T. Voltage taps monitored the inner 4 layers and outer 2 layers of the coil, both whilst ramping up and when shutting off the current from 300 Amps to zero. The coil was tested at 10 K at close to 100% of the short sample performance without any voltage generated, which is a clear confidence check for the consistency of the 1+6 MgB_2 cable over long lengths.

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