Effect of Mechanical Support Conditions of Winding on the Strain Development of a Composite MgB_2 Based Full Body MRI Coil

A. A. Amin[1], T. N. Baig[3], R. J. Deissler[3], L. Sabri[1], D. Doll[2], M. Tomsic[2], O. Akkus[1] and M. A. Martens[3]

[1] Case Western Reserve University, Department of Mechanical and Aerospace Engineering, OH 44106 USA
[2] Hypertech Research, Columbus OH 43228 USA
[3] Case Western Reserve University, Department of Physics, OH 44106 USA

Email: aaa196@case.edu

***Abstract*— The winding of composite superconducting wire around a mandrel is one of the first stages of manufacturing processes of a superconducting magnet. Depending on the method of mechanical support conditions during winding, the strain development at the final stage in a superconducting magnet may vary significantly. Therefore, proper selection of the winding process is important to increase the feasibility for a conduction cooled full body MRI magnet based on magnesium diboride (MgB_2), a strain sensitive high temperature (HTS) superconductor. A multiscale multiphysics Finite Element Analysis (FEA) model of an 18 filament MgB_2 wire is developed for strain estimation. The computationally homogenized representative volume element (RVE) of the composite wire is used in the coil bundle in place of the actual MgB_2 wire. The simulation considers winding, thermal cool-down and electromagnetic charging to estimate total strain developed at the final step— electromagnetic charging. Four different types of support conditions are studied and strain development is reported. Results suggest that a combination of radial and axial support at the inner radial surface and outermost axial surfaces of the mandrel respectively is the most favorable winding condition with a minimum strain development of 0.021% which is half in comparison to no mandrel support.**

***Keywords (Index Terms)*— Finite element analysis, ANSYS, superconducting coils, MRI, multiphysics, multiscale modeling.**

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