Industrialization of Radiation-Resistant Cyanate Ester Magnet Insulation

Matthew W. Hooker, Steven A. Arzberger, Samuel D. Grandlienard, Michael W. Stewart, Naseem A. Munshi, Garry M. Voss, Robert D. Benson, and Madhu S. Madhukar

Abstract — Future magnet systems require electrical insulation that can withstand high levels of incident radiation, while also providing the necessary mechanical robustness and dielectric strength to operate these devices. Moreover, the insulation must also be compatible with industrial fabrication processes to enable their efficient, large-scale manufacture. Cyanate ester-based insulations provide the necessary electro-mechanical performance and radiation resistance for these applications, but more information is needed to demonstrate application-specific issues related to magnet production. To accomplish this, a series of tests were performed to validate the long-term processing behavior of cyanate ester resins, their adhesion to Kapton®, and the fabrication of small-scale coils. The results of this work demonstrated a working time of greater than 85 hours, good adhesion to Kapton®, and the successful fabrication of test coils. Larger-scale industrial trials are ongoing at various sites to further demonstrate the use of cyanate ester insulation for the ITER TF coils, as well as commercial applications.

Index Terms—cryogenic, cyanate ester, insulation, radiation resistant

Manuscript received 15 August 2008. This work was supported in part by the U.S. Department of Energy under Grant number DE-FG02-07ER86306.

M.W. Hooker, S.A. Arzberger, S.D. Grandlienard, M.W. Stewart, and N.A. Munshi are with Composite Technology Development, Inc., Lafayette, CO 80026 USA (e-mail: matt.hooker@ctd-materials.com).

G.M. Voss is with the Culham Science Centre, United Kingdom Atomic Energy Authority, Oxfordshire OX14 3DB, UK (e-mail: garry.voss@ukaea.org.uk).

R.D. Benson and M.S. Madhukar are with the Department of Mechanical, Aerospace, and Biomedical Engineering, University of Tennessee, Knoxville, TN 37932 USA (e-mail: mmadhuka@utk.edu).