T_CSUH Special Seminar

Texas Center for Superconductivity at the University of Houston

Dr. Sasha Ishmael
PostDoctoral Research Scholar
North Carolina State University

Thursday, November 14, 2013
Room 102, University of Houston Science Center
12:00 noon – 1:00 p.m.

Improving high temperature superconducting magnet quench detection and protection: Utilizing nanopowder titania based electrical insulation with high thermal conductivity

ABSTRACT

Quench protection constitutes a major challenge for the widespread implementation of HTS-based magnets. Quench protection for practical devices requires improvements in both the speed and reliability of existing quench detection techniques. This is due to the slow normal zone propagation velocity (NZPV) in high temperature superconductors (HTS) such as Bi2Sr2CaCu2OX (Bi2212) and YBa2Cu3O7-x (YBCO). While several suggested approaches to improve quench protection in HTS magnets increase the NZPV, they have the undesirable effect of reducing the minimum quench energy (MQE). This seminar discusses a novel approach that utilizes nanopowder titania based electrical insulation with high thermal conductivity as the turn-to-turn insulation within superconducting magnets. This insulation is optimized for the requirements of practical HTS magnet operation. Thin layers of the insulation are deposited onto the surface of Bi2212 and YBCO wires, which are then wound into coils to study the resulting quench behavior. These results indicate that nanopowder titania insulation significantly improves quench detection in Bi2212 and YBCO coils without compromising magnet stability. Increased normal zone propagation velocity in axial and transverse direction facilitates quench detection and therefore improves quench protection. The reduced thickness of the insulation relative to conventional alternatives also increases the engineering current density in the magnet windings and simultaneously reduces the coil enthalpy.

BIO

Dr. Ishmael received her Ph.D. in 2010, in electrical engineering from Florida Institute of Technology. Her dissertation focused on a design of a superconducting synchronous condenser based on magnesium di-boride (MgB_2) for reactive power support of the electric grid. The design developed in her dissertation was the first superconducting condenser developed for MgB_2 and utilized a unique 3D winding configuration for the rotor of the machine. She also worked as an engineer at the Advanced Magnet Lab. Inc. During her seven years at the company she designed and tested a variety of resistive and superconducting magnets for power, medical and research applications.

Currently Dr. Ishmael works in the research group of Professor Justin Schwartz, at the Department of Materials Science and Engineering at the North Carolina State University. The group's primary research addresses the underlying science of advanced materials used in High Temperature Superconductor (HTS) wire for magnet applications. Her main research is focused on the characterization of MgB_2 for Fault Current Limiters, quench detection based on Rayleigh scattering in fiber-optics and nanomaterials for electrical insulation with high thermal conductivity for HTS applications.