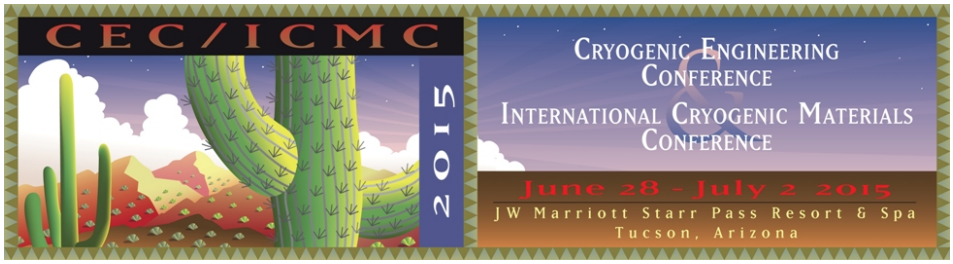

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Quench detection via Rayleigh scattering based fiber optic distributed sensors

Tuesday, 30 June 2015 09:00 (2 hours)

A novel quench detection method is developed and tested using optical fibers as distributed sensors of temperature and strain. In particular, the technique is based on the comparison of Rayleigh backscattering signals of a reference and perturbed state. A spectral shift quantifies the mismatch between the two conditions, which depends on temperature and strain changes between the two compared states. Several HTS coils have been fabricated and instrumented with voltage taps, thermocouples and an embedded heater to initiate a quench. An optical fiber has been co-wound with YBCO tape using different schemes. The results showed that the spectral shift correlates with normal zones developed in the coil. In all the experiments the fiber optic based detection system was able to rapidly detect and locate normal zones, with very high spatial resolution (5 mm) and fast measurement (a measurement cycle lasts 30 ms). Moreover, the spectral shift raised as soon as a thermal perturbation occurred, without any time delay whatsoever, whereas the voltage signal started rising only after the temperature crosses Tcs. The combination of high spatial resolution (5 mm) and high speed (a measurement cycle lasts 30 ms) allowed for a very rapid detection and localization of a hotspot. These capabilities enable the use of a minimum propagating zone (MPZ) as a criterion to identify unstable (propagating) normal zones, instead of the conventional threshold voltage.

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