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Self-monitoring, SMART REBCO coated conductors

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The development of second generation (2G) high temperature superconductor (HTS) wires has allowed for achieving performance levels that are suitable for numerous applications and allow for the generation of the high magnetic field required in applications like future particle colliders. In fact, 2G HTS technology is currently being employed in fault current limiters (FCLs), energy storage devices, motors and generators, different cable configurations and high field magnet applications. Any technology based on HTS, however, still suffers from the fact that conventional quench detection techniques result insufficient and ineffective when applied to HTS based systems. A novel way to address the quench detection challenge is represented by Rayleigh backscattering interrogated optical fibers (RIOF). The ultimate way to integrate optical fibers into coils is to embed them directly in the conductor. Here the quench detection challenge in HTS has been addressed by developing conductors that are able to self-monitor their status, detecting incipient, local transitions to the normal state. The feasibility of a 2G HTS wire incorporating an optical fiber has been demonstrated. The embedded optical fiber is interrogated by Rayleigh backscattering and therefore presents all the advantages of the RIOF approach, with the addition of ultimate sensitivity and complete cancelation of reduction in winding packing density. In fact, with the development of such a coated conductor, the optical fiber doesn't take up any additional space in a magnet, leaving the magnet design completely unchanged. Straight samples and small coils of SMART conductor have been characterized and used in quench experiments, showing the potential of the SMART conductor technology.

Submitters Country

United States

Primary author: SCURTI, Federico (NCSU)

Co-authors: Dr SATHYAMURTHY, Srivatsan (American Superconductor Corporatio); Dr RUPICH, Martin (American Superconductor Corporation); SCHWARTZ, Justin (NC State University)

Presenter: SCURTI, Federico (NCSU)

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