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C3Po1A-07 [18]: Strain measurement using FBG sensor in a rosette configuration for HTS applications

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Most of the mechanical property issues in coated conductors are still unknown. Some of the predictive models that's has been currently developed have a difficulty in defining the parameters that critically influence stress states of the conductor layers. Also the material properties like young's modulus; thermal expansion has been assumed in those models. As a result, these models can only give an idea of the stress states in different layers of the coated conductors but not the actual stress states. Measuring the actual stresses can reveal more basic science fact. This in turn can help the developers to solve the electro-mechanical design and engineering issues in the coated conductors. Hence, in order to get the actual stress states, it is essential to measure it experimentally. Unfortunately, the standard sensor like strain gauges cannot be placed inside the substrate/ layers of the coated conductor. So it is impossible to access local stress states in the layers of the conductor using present measurement systems. Bragg gratings fabricated at different location in a single fiber is better suited for this purpose. Gratings with different spatial period can be arranged at various positions along a single mode fiber on the substrate of the conductor. The sensor array could be embedded by recoating the conductor by sputtering technique. Conductor stress will vary the gratings periods, which can be read out with a tunable laser in a wavelength division-multiplexing (WDM) scheme. The spectral position of the reflections may be correlated with the spatial position of the gratings, and the shift of the gratings' maximum reflection indicates the change of the gratings' period, which in turn measures actual stress. In this paper, the design and technology requirements to adapt the WDM FBG sensor concept for coated conductors is presented. Initial experiments, which demonstrate the torsional stress distribution at room temperature and at 77 K is reported.

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