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Effects of metallic coatings on the thermal sensitivity of optical fiber sensors at cryogenic sensors

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One promising new application for optical fiber sensors is in monitoring superconducting magnets that are, inevitably, operated at cryogenic temperatures. In fact, Rayleigh backscattering interrogated optical fibers have been shown to be a viable alternative to voltage taps in quench detection of high temperature superconductors. The cryogenic thermal sensitivity of commercially available optical fibers is depressed by the low coefficient of thermal expansion of the constituent materials. Here, single mode, telecommunication-grade optical fibers are coated with different metals to alter their sensitivity to thermal perturbation at temperatures as low as 4.2 K. Commercially available fibers with acrylate coating are compared to fibers with only metallic coatings, those with and acrylate-metal composite coatings, in terms of their sensitivity to thermal perturbations in the temperature range from 4.2 to 61 K. All the metallic coatings are deposited in house with a dedicated coating method. The metals considered include Sn, PbSnAg and InBi, both on cladding and on an acrylate primary coating. Results show that the 4.2 K thermal sensitivity can be enhanced significantly by a composite coating approach.

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