High γ-ray dose radiation effects on the performances of Brillouin scattering based optical fiber sensors

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Abstract: The use of distributed strain and temperature in optical fiber sensors based on Brillouin scattering for the monitoring of nuclear waste repository requires investigation of their performance changes under irradiation. For this purpose, we irradiated various fiber types at high gamma doses which represented the harsh environment constraints associated with the considered application. Radiation leads to two phenomena impacting the Brillouin scattering: 1) decreasing in the fiber linear transmission through the radiation-induced attenuation (RIA) phenomenon which impacts distance range and 2) modifying the Brillouin scattering properties, both intrinsic frequency position of Brillouin loss and its dependence on strain and temperature. We then examined the dose dependence of these radiation-induced changes in the 1 to 10 MGy dose range, showing that the responses strongly depend on the fiber composition. We characterized the radiation effects on strain and temperature coefficients, dependencies of the Brillouin frequency, providing evidence for a strong robustness of these intrinsic properties against radiations. From our results, Fluorine-doped fibers appear to be very promising candidates for temperature and strain sensing through Brillouin-based sensors in high gamma-ray dose radiative environments.

OCIS codes: (060 2370) Fiber optics sensors; (060 0060) Fiber optics and optical communications; (350.5610) Radiation

References and links

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