Supplement of

Distributed fiber optic radiation sensors

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BAM 8.6 Fibre Optic Sensors

Why distributed fiber optic sensors for nuclear environments?

Because fiber optic sensors (FOS) can measure:
- at ionizing radiation
- in strong electromagnetic fields
- at high temperatures
- at hard-to-reach places
- over long distances (distributed)
- in real-time
- several physical quantities (temperature, strain, humidity etc.) at the same time (multiparameter sensors)

Fiber optic dosimetry can be realized by detecting:
- radiation-induced attenuation (RIA)
- refractive index change
- radio-, thermo- and optically-induced luminescence

Distributed fiber optic radiation sensors based on glass optical fibers (GOFs)

➢ sensitivity of the radiation sensors can be influenced by the choice of dopants in the fiber core
➢ spatially resolved monitoring along kilometer-long sensing fibers

RIA of two different doped radiation-sensitive glass optical fibers.

Wosniok, A., et al. (2016), Gamma radiation influence on silica optical fibers measured by optical backscatter reflectometry and Brillouin sensing technique, Proc. of SPIE, 9916

Distributed fiber optic radiation sensors based on polymer optical fibers (POFs)

➢ sensitivity of the radiation sensors can be influenced by the type of polymer material
➢ dose resolution in the range of a few Gy by measuring RIA
➢ monitoring by strong longitudinal strain

Experimental configuration for POF irradiation (top) and RIA increase after irradiation to 20 Gy (bottom left) with the reconstructed dose distribution (bottom right).

Stajanca, P., and Krebber, K. (2017), Radiation-induced attenuation of perfluorinated polymer optical fibers for radiation monitoring, sensors, 17(9)

Summary

The RIA sensor response of POF- and GOF-based sensors is dependent on:
- wavelength of the used laser source
- dose rate
- environmental temperature

Application areas of fiber optic radiation monitoring:
- nuclear power plants
- particle accelerators
- nuclear waste repositories
- radiation profiling of nuclear waste containers

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