Comparison of Radiation-Induced-Attenuation in Pure Silica Core and F-doped Silica fibres

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Pure silica core (PSC) fibres with fluorine-doped cladding exhibit superior resistance to ionizing radiation, as quantified by the transmission losses (radiation induced attenuation – RIA) induced by exposure to such radiation. Several decades ago, it was reported [1] that F-doped fibres, i.e. fluorine doping of the core at a lower level than in the cladding, exhibit further improvement in resistance to ionizing radiation.

We have exposed pure silica core and F-doped single-mode fibres to intense ionizing radiation (neutrons and gamma rays) by placing them in the core of a research grade nuclear reactor, and simultaneously measuring the fibre transmissions at 1310 nm and 1550 nm. Indeed the F-doped fibre showed lower RIA than the PSC fibre at the beginning of the experiment. However, after several days of irradiation the RIA of the F-doped fibre surpassed that of the PSC (see Fig. 1). This behaviour may be explained by the RIA being caused by two types of defects whose initial concentrations and distributions differ in the two as-drawn fibres [2], and can be further generated when the ionizing radiation damages the silica structure.

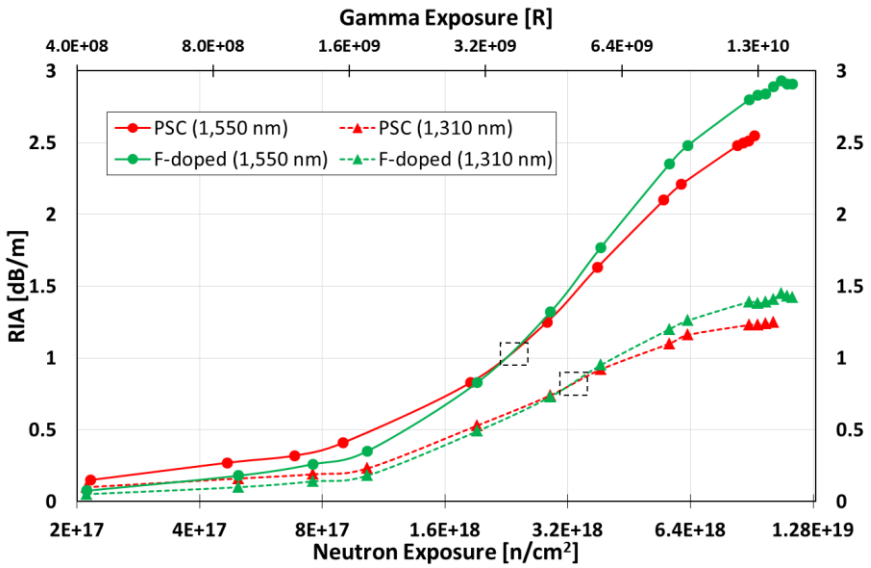

Figure 1. Radiation induced attenuation at 1550 and 1310 nm for PSC (red) and F-doped (green) fibres as a function of accumulated radiation dose. The squares indicate the doses above which the RIA of the F-doped fibre surpasses that of the PSC fibre.

[1] K. Sanada, N. Shamoto and K. Inada "Radiation resistance of fluorine-doped silica-core fibers", *J. Non-Crystalline Solids* **179**, 339 (1994)

[2] A.L. Tomashuk, M.Yu. Salgansky, P.F. Kashaykin, V.F. Khopin, A.I. Sultangulova, K.N. Nishchev, S.E. Borisovsky, A.N. Guryanov, and E.M. Dianov, *J. Lightwave Technology* **32**, 213(2014)