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SiOx coated plastic fiber optic sensor for gas monitoring in RPC

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A new sensor for the measurement of fluoride ions in dielectric gas mixtures has been developed. The sensor has been specifically designed to be installed at the RPC Closed Loop gas system in the CMS experiment at the Large Hadron Collider at CERN.

The sensor employs a plastic optic fiber (POF) coated with a SiO_2-like thin film. F- ions attack the glass-like layer and alter the fiber transmission capability that can be revealed by a photodiode. The coated POF is obtained by means of low pressure plasma processes that allow both the etching of the fiber cladding and the PECVD deposition of SiOx films at low temperature directly onto the fiber core, without damaging it. The sensor exploits a cumulative behavior so that long expositions to extremely low concentrations can be detected. The characteristics of fiber optics sensors, such as immunity to electrostatic discharge and the intrinsic small sensor dimension, make them particularly suitable for an in situ monitoring in the presence of ionizing radiations. Some tests at the Gamma Irradiation Facility (GIF) at CERN confirm the sensor feasibility; no changes in the transmission ratio were recorded on fibers left in place for about six months exposing them to a dose of about 2 Gy, corresponding to several months of typical CMS operation.

Prototypes of POF sensors coated with SiOx films deposited in different conditions have been tested in laboratory by exposing them to fluoride vapors showing sensitivities of up to 0.02% / (ppm x hour).

Primary author: Dr GRASSINI, Sabrina (Politecnico di Torino)

Co-authors: Dr PICCOLO, Davide (INFN National Laboratories Frascati); Dr BENUSSI, Luigi (INFN National Laboratories Frascati); Dr ISHTAIWI, Maen (Politecnico di Torino); Prof. PARVIS, Marco (Politecnico di Torio); Dr BIANCO, Stefano (INFN National Laboratories Frascati); Dr COLAFRANCESCHI, Stefano (INFN National Laboratories Frascati)

Presenter: Dr GRASSINI, Sabrina (Politecnico di Torino)

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