OPTICAL FIBER SENSORS FOR EARTH SCIENCES: FROM BASIC CONCEPTS TO OPTIMISING GLASS COMPOSITION FOR HIGH TEMPERATURE APPLICATIONS

G. Brambilla, H.H. Kee, V. Pruneri*, and T.P. Newson

Optoelectronics Research Centre, University of Southampton, Southampton, SO17 1BJ, UK.
*Now with O.T.I. – Corning, Viale Sarca 222, Milano, Italy
E-mail: gb2@orc.soton.ac.uk

The technical evolution in the field of optical fibre sensors is reviewed with particular reference to high temperature measurements. Optimisation of fibre composition and system design to fully realise the potential of these sensors has led to the substantial advances in both distributed and point sensor systems. Distributed sensing techniques based on Rayleigh, Raman and Brillouin scattering with their dependences on strain and temperature are examined. The use of spontaneous Brillouin scattering is demonstrated to achieve both short and long range temperature sensing with high spatial and temperature sensitivities. Simultaneous distributed strain and temperature sensing is also demonstrated by measuring both the Brillouin intensity and frequency shift. Remote sensing for applications in volcanic areas and deep borehole monitoring is discussed. A review of point sensors is also proposed, with particular stress on devices for earth science applications like seismometers, position, strain and chemical sensors. Intrinsic sensors based on microbending, evanescent field and fibre Bragg gratings are examined. Temperature resistance of gratings written in different fibres is compared and fibre glass composition is optimised for high temperature applications. Gratings written in tin doped fibre shows enhanced thermal stability and excellent reliability up to a temperature of approximately 800 ^{O}C.