Long-term stability decay of standard and regenerated Bragg gratings tailored for high temperature operation

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***Abstract*— Thermal stability of both standard and regenerated Bragg gratings written in normal and photosensitive optical fibers was accessed. An apparent spectral wavelength stabilization of common gratings with no thermal hysteresis was reached after thermal treatments. However, after a time interval of 5 months, gratings exhibited a shift in the resonance Bragg wavelength at room temperature, as well as important changes in the thermal sensitivity above 200 ºC. Regenerated gratings proved to be stable only at temperatures below the critical regeneration temperature, with significant loss of reflectivity above that critical value.**

***Index Terms*—** Bragg sensors, High temperature, Decay stability.

I. INTRODUCTION

Fiber Bragg gratings – FBG and recently regenerated-fiber Bragg gratings - RFBG have a great potential for applications as sensors. FBGs have been employed for sensing temperature, mechanical strain, pressure and refractive index [1], [2], [3]. Any external parameter that affects the effective refractive index of the fiber core and/or the grating period may result in a change of the reflected wavelength and might be sensed. Despite their ubiquity, the long term thermal stability of FBG sensors is an important issue to allow their efficient use. Spectral stability is related to the defects responsible by the refractive index modulation that constitutes the FBG. These defects can be thermally activated resulting in changes in the refractive index modulation and consequently affecting spectral characteristics of the FBG based sensor. Due to this drawback, FBG temperature sensors are usually employed in applications with typical operation temperatures below 200°C [4]. Along the past few years, many process as thermal treatments and fiber co-doping were proposed to enhance the FBG stability and lifetime [5]-[8]. Besides, a new class of grating produced by thermal regeneration of fiber Bragg gratings, emerged as a solution for the sensors stability problems [9]-[11]. Mechanism responsible by the FBG regeneration is not completely understood but it seems to be related to defects diffusion [12] and silica compaction and densification [10], [13]. Regenerated fiber Bragg gratings –

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