Comparison of regenerated fiber Bragg gratings properties in standard and B/Ge co-doped single-mode silica fibers

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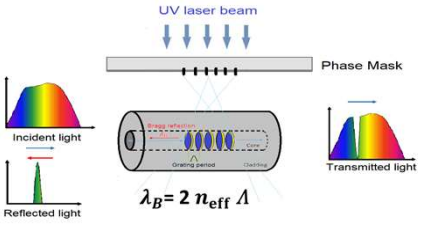
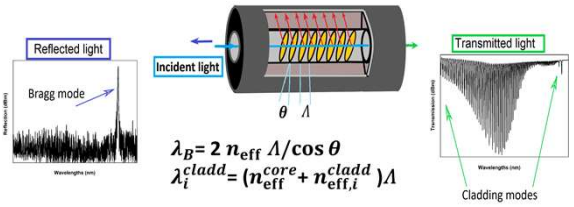
ABSTRACT- This research compares thermal regeneration process of uniform Bragg gratings (FBGs) and tilted Bragg gratings (TFBGs) written by ArF UV laser (193 nm) in standard single-mode silica fiber (Corning SMF-28) and photosensitive B/Ge co-doped optical fiber (fiberCore PS-1250/1500). By monitoring the reflection and transmission spectra of the gratings, we show that TFBG written in SMF-28 regenerates at 950 ˚C with efficiencies of 2.06% and 1.10% for the core mode and cladding modes, respectively. On the other hand, TFBG written in PS fiber regenerates at 500 ˚C due to doping with regeneration efficiencies of 1.27% and 0.16% for the core and cladding modes, respectively.

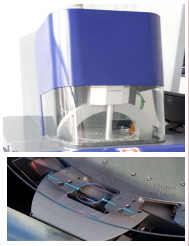
What is an FBG?



What is a TFBG?



Phase mask technique
NORIA system
UV laser
@193 nm



FBGs are key component in optical sening. TFBGs present all the advantages of FBGs, moreover, they are able to excite cladding mode resonances. TFBGs are sensitive to bending and surrounding refractive index (SRI).
High temperature sensing is possible using thermal regenerated UV-inscribed gratingss.

What is thermal regeneration?

In this process, a seed grating is annealed at high temperature (700 ˚C -1000 ˚C) until this grating vanishes and a new grating rebuilds from the initial footprint so-called "regenerated grating (RFBG)".

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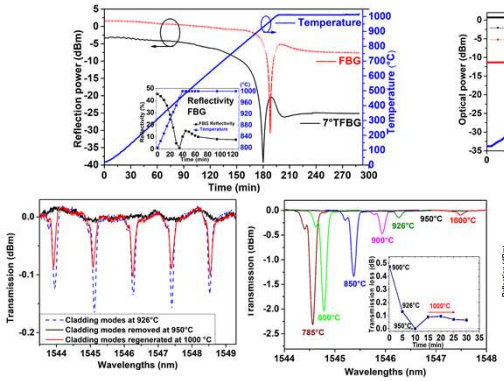
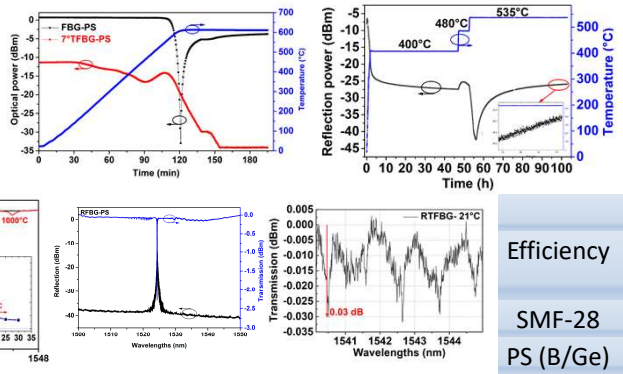
Experimental results

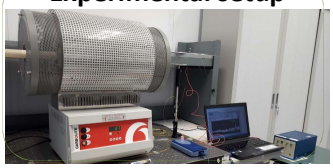
Gratings in SMF-28 fiber



Gratings in B/Ge co-doped PS fiber



Experimental setup



Efficiency	FBG	TFBG	
	Core mode	Core mode	Cladding modes
SMF-28	7.44%	2.06%	1.27%
PS (B/Ge)	37.14%	1.10%	0.16%

Application and Conclusion:

Thermal regeneration of FBGs and TFBGs shows a behavior depending on the fiber chemical composition.
Regenerated gratings in SMF fiber can be operated for high temperature sensing applications up to 1000 ˚C .
Regenerated gratings in PS fiber can be used for temperature and strain sensing application up to 900 ˚C , as in their regeneration process lower temperature is used, they preserve stronger mechanichal properties.
For Chemical/physical sensing at high temperatures, regenerated TFBGs in SMF-28 are possible candidates, whereas regenerated TFBGs in PS fibers are not usable.