The one-side UV illumination causes UV induced birefringence that leads to grating PDL and DGD

We use a 3 steps manufacturing process in which gratings are written in twisted-fibers along their axis

1. Twist the fiber
2. Write the FBG
3. Relax the fiber

Experimental realizations

4 FBGs were written over 1 cm of 30 cm twisted-fiber

− FBGs written
  − in co-doped Bore/Germanium photosensitive SMF
  − by means of phase mask technique using 244 nm laser (frequency-doubled argon-ion)
  − 1 cm long; 12 dB amplitude rejection

Twisted fibers:

− N = number of turns over 30 cm
− θ = rotation angle over FBG (1 cm): (N*360°)/130

Experimental results

Same amplitude spectrum for the 4 FBG

⇒ Experimental results point out an important reduction (>50%) of PDL and DGD for 388° rotation FBG

Simulations

− Simulations parameters
  − 8.10⁴ modulation index, 1 cm length
  − birefringence Δ_n = 8.10⁴
  − 0°, 180°, 240°, 360° twisted-FBG (angle value: rotation of polarization axis over the grating length)

− Results
  − Unchanged amplitude responses
  − PDL and DGD
  − curves shape are globally the same
  − weaker values when rotation angle increases:
    − rotation: 0° → 360°
    − PDL: 0.8 dB → 0.1 dB
    − DGD: 4 ps → 0.5 ps
  − reduction ~1/8

Simulations results point out the reduction of PDL and DGD for our twisted-FBG

Typical grating responses

It is therefore important to find solutions to reduce the photo-induced birefringence effects

⇒ two methods can be investigated

1. decreasing the birefringence value itself
  − How? ⇒ by a more symmetric manufacturing process
    − e.g., dual exposure method [Vangourke, Opt. Let. 1994]

2. decreasing the effects of the birefringence
  − How? ⇒ by inducing polarization mode coupling (PMC) (birefringence value remains constant)
  − NB: same principle that used in the case of “spun fibers” to obtain optical fibers with low DGD values