Invited

LIGHT INDUCED STRESSES IN SILICA FIBERS

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Doped silica and in particular germano-silica fibers are known for decades to be sensitive to UV light. As a result of light exposure, doped silica glass changes its dielectric constant. As germano-silica glass is much more photosensitive than silica glass, the exposure of optical fiber leads to refractive index (RI) changes in the fiber core. Periodic RI changes act as a phase grating and couple light between different fiber modes, e.g. forward to backward traveling core modes (fiber Bragg gratings) or forward traveling core and cladding modes (long period gratings). Such gratings became widely used as wavelength selective filters in telecom and sensing applications.
However, the underlying phenomena are far from being understood. The photosensitivity is triggered by the absorption of one or more photons by a color center (GeO_2, GeO) or across the band gap that lead to mainly three effects: creation and bleaching of color centers [1], relaxation of mechanical induced stresses [2], and changes in the glass network structure, i.e. glass compaction or dilatation [3] accompanied by stress changes [4]. Depending on the light source, the optical fiber, and its photosensitization (e.g. H_2-loading), only one single or several effects contribute to glass photosensitivity.
In this presentation I will review the state of the art of stress measurements in optical fibers, the origin of residual stresses, and stress changes induced by different light, e.g. UV-nanosecond, near infrared- and UV-femtosecond laser light in correlation to index changes observed in fiber gratings. Elastic stresses and inelastic strains present in the optical fiber lead to birefringence induced retardation, which is measured using a polariscope. Using Abel or Inverse Radon transformations, the fiber birefringence, the inelastic strain, the stress distributions and the photo-elastic index changes are obtained from the radial retardation profile. A comparison with total index changes obtained from grating spectra can help clarifying the underlying process. Examples of positive grating index changes correlated to positive stress changes, which indicate a compaction of the fiber core and grating index changes with no stress changes, indicating color center changes only will be given.

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[4] P. Y. Fonjallaz, H. G. Limberger et al. *Opt. Lett.* **20**, 1346 (1995); H. G. Limberger, et al. *Appl. Phys. Lett.* **68**, 3069 (1996); F. Dürr, H. G. Limberger, et al. *Appl. Phys. Lett.* **84**, 4983 (2004).

PRIMARY TOPIC: E
SECONDARY TOPIC: I
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PREFERRED FORMAT OF PRESENTATION (ORAL/POSTER): Invited

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