CONERENCE PROGRAM
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Valery Kozlov, Corning Inc., United States

SOTuC3 Development of a Novel Cladding-doped Optical Fiber with Au Metal Nano-particles for Surface Plasmon Resonance Sensor Applications
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SOTuC4 Visible Light Emitting Optical Fibers using Up-Conversion
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SOTuC5 Optical fiber sensors and their Specialty Fiber Needs
Alexis Mendez, MCH Engineering, LLC, United States
Development of a Novel Cladding-doped Optical Fiber with Au Metal Nano-particles for Surface Plasmon Resonance Sensor Applications

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Abstract: A novel optical fiber having its cladding doped with Au metal nano-particles was developed. The enhanced surface plasmon resonance without using metal thin film on the fiber surface was obtained.

OCIS codes: (160.4236) Nano-particles; (060.2310) Cladding-doped optical fiber; (240,6680) Surface plasmon resonance;

Recently, optical fiber sensors based on surface plasmon resonance (SPR) have drawn much attention because of their capabilities of measurements of various chemical, physical, and biological quantities with all-optical scheme, high sensitivity, and real-time remote sensing, etc. [1-5]. The SPR based optical fiber sensors usually use thin metal film or nano-particles of Au or Ag as a plasmonic material due to its sharp and intense plasmonic band when excited in the Kretschmann configuration of SPR [1-3]. To increase the SPR sensitivity, various types of optical fibers such as polished fiber, tapered fiber, grated fiber, and coated fiber have been suggested and effect of size, thickness, shape, and composition of plasmonic materials have mainly been studied [4,5].

We develop a novel specialty optical fiber incorporated with Au metal nano-particles (MNs) in cladding region to enhance SPR sensitivity without using coated metal thin film on the fiber surface. The optical glass fiber incorporated with Au MNPs in cladding region was fabricated by using the modified chemical vapor deposition (MCVD) and the fiber drawing process. To incorporate Au MNPs in cladding region of a fiber preform, silica glass cladding layers were first deposited by using the MCVD process and partially sintered in a silica glass tube. Then the porous cladding layers were soaked with doping solution and the tube was dried, sintered and jacketed with germano-silicate glass rod (refractive index = 1.4629 @ 633nm). Then the outer cladding of the fiber preform was etched (Fig. 1). Finally, the fiber preform was drawn into a fiber by using the draw tower at 2150°C. During the drawing process, the fiber was coated with low refractive index polymer (EFIRON UVF PC-375, n=1.382, which is less than that of the silica glass) to induce total internal reflection of light signal. The core and cladding diameters of the Au MNPs cladding-doped optical fiber were 25 μm and 125 μm, respectively.

The measured absorption band of the fiber preform appeared peaking at 585 nm and it can be attributed to the large concentration of the Au MNPs in the cladding region. However, in the case of optical fiber (drawn from the same preform), the significant absorption peak due to surface plasmon resonance from Au MNPs was found to appear at 395 nm. The decrease in the SPR peak wavelength of the fiber compared to that of the fiber preform was due to increase in Au MNPs size through recrystallization of the Au MNPs in the fiber preform during the drawing process at 2150°C. SPR spectrum was measured by putting small drops of the refractive index matching oil (n=1.480) directly on the surface of the Au MNPs cladding-doped optical fiber without using metal thin film and the SPR peak was found to appear at 1363 nm.

References