

Abstract

Research on Optical Properties of a Tapered Optical Fiber with Higher Alkane Cladding Doped with Fe₃O₄ Nanoparticles [†]

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Abstract: The presented research shows the effect of mixing Fe₃O₄ nanoparticles with higher alkanes on the propagation of the light wave in a biconical, adiabatic optical fiber taper. A fiber optic taper makes it possible to directly influence the light parameters inside the taper without the necessity of leading the beam out of the structure. The mixture of alkanes and Fe₃O₄ nanoparticles forms a special cladding surrounding the fiber taper, which can be controlled by temperature and magnetic fields. The results show changes in beam intensity and polarization properties, such as the azimuth, ellipticity, depending on mixture temperature, aggregation of nanoparticles, and different applied magnetic fields. The taper is made of a standard single-mode telecommunication fiber, pulled out to a length of 25.0 ± 0.5 mm. The diameter of the tapers is around 8.0 ± 0.3 μm. Such a taper causes the beam to leak out of a waist structure and allows the addition of external beam-controlling cladding material. The built-in sensor containing nanoparticles operates according to the on-off principle, as well as with changes in the nanoparticles' position around the taper. Nanoparticles added to the alkanes cause an increase in hysteresis via a heating and cooling process. Magnetic particles can change their positional influence on the light propagation and polarization parameters. Such a mixture also creates a significant shift in the temperature characteristics during the heating process, in which the mixture changes its physical state with the simultaneous slight shifting of the characteristics during cooling. The data covers a wide spectral range of 500 to 1700 nm. Temperature tests for the selected lengths in the visible and infrared range are determined.

Keywords: magnetic nanoparticles; optical fiber taper; optical sensors; alkanes



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