



Chirped waveguides application for definition of the blood type



A.V. Malinin^{1,2}, A.A. Zanishevskaya^{1,2}, Yu. S. Skibina^{1,2}, I. Yu. Silokhin²,
V.V. Tuchin^{1,3}, V.A. Dubrovskiy⁴, A.A. Dolmashkin⁴

¹Saratov State University, 83, Astrakhanskaja str., Saratov, 410012 Russia;

²SPE Nanostructured Glass Technology, 101, 50 let Oktjabrja ave., Saratov, 410033 Russia;

³Institute of Precise Mechanics and Control RAS, 24 Rabochaya str., Saratov, 410028 Russia;

⁴Saratov State Medical University, 112, Bolshaya Kazachaya str., Saratov, 410012 Russia.



Motivation

Chirped photonic crystal fiber (PCF) represents a structure of two-dimensional photonic crystal in its cross-section. Photonic crystal is a dielectric medium with periodic spatial modulation of dielectric constant. Spectral characteristics of photonic crystal fibers depend on internal geometry of the fiber, but at the same time, optical properties of medium, filling the hollow core of PCF like refractive index, coefficient of scattering and absorption, make a significant impact to PCF's guiding properties.

A significant influence of internal medium scattering coefficient on a PCF's guiding properties becomes basis for design of blood typing automatization technique specifically. Recently obtained experimental results, regarding PCF's sensitivity for internal medium optical properties changing, are presented as well.

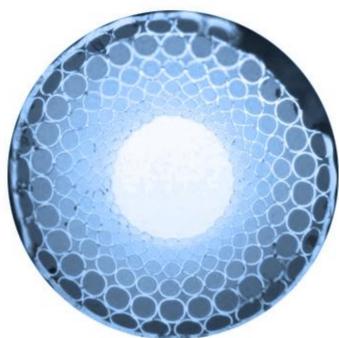


Fig.1. Cross-sections of a photonic crystal fiber with external diameter 1013 μm , hollow core diameter 284 μm , middlemost capillary diameter 1.15 μm and wall thickness 2.28 μm .

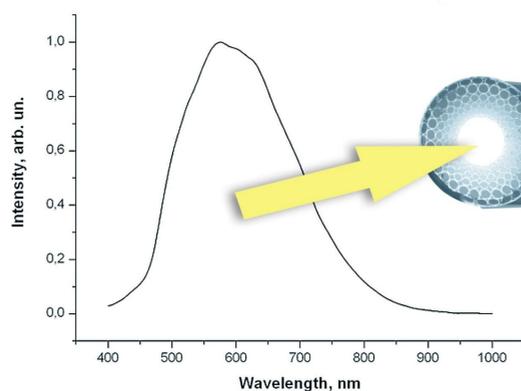


Fig. 2. Optical spectrum of a source of radiation.

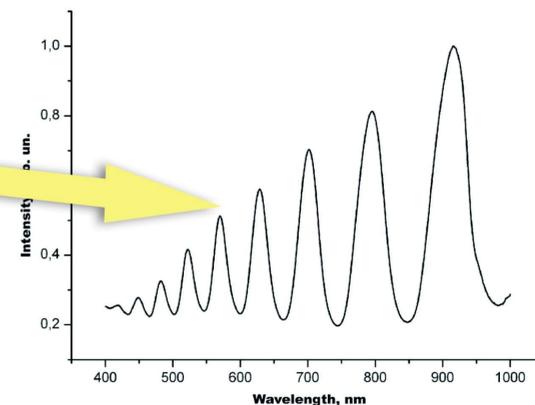
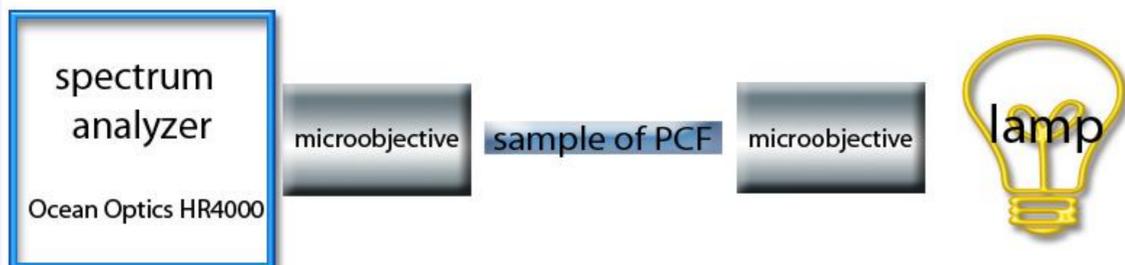


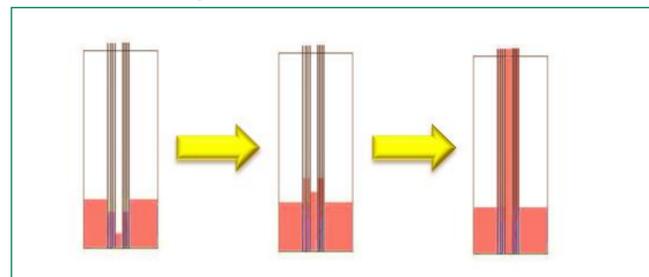
Fig. 3. Optical spectrum of non-filled PCF with hollow core .

The length of the sample of PCF is 0.05m.

Fig. 4. Optical scheme of experimental device.



Filling structure of PCF with hollow core:



Radiation from source of light is focused directly to hollow core of PCF, in output side of fiber information of transmitted radiation collected by optical fiber with connection in optical spectrum analyzer.

Blood type	Agglutination serum type			
	0(I)	A(II)	B(III)	AB(IV)
0(I)	-	-	-	-
A(II)	+	-	+	-
B(III)	+	+	-	-
AB(IV)	+	+	+	-

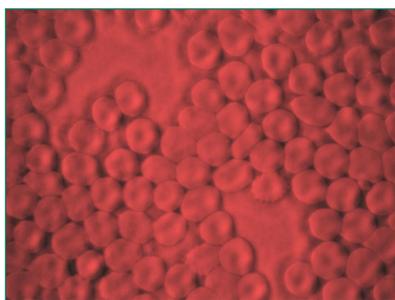


Fig. 5. Red blood cells.

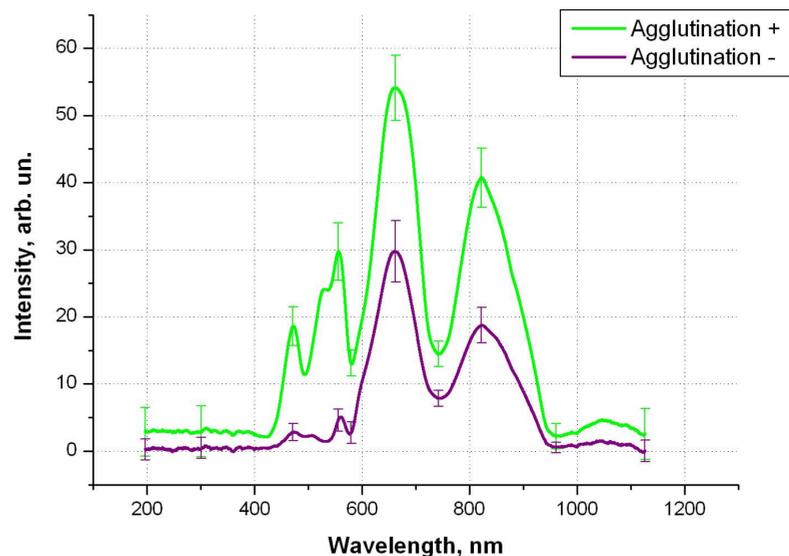


Fig.6. Averaged transmission spectra of identical chirped PCF with hollow core diameter 270 μm , filled with product of blood cells positive and negative agglutinating reaction. Errors of measurement at different wavelengths are indicated.

Agglutinating serum of A + whole blood of B type, diluted by saline to hematocrit 0.8%

Summary

Due to its sensitivity to optical properties of internal medium, chirped PSF can be used in blood typing automatic systems. In order to introduce such a technique, additional statistical investigations are required. Because of using blood samples from different donors, experimental data deviations are expected. However, quite simple method of producing of chirped PCF with different internal sizes and spectral characteristics allows one to optimize developing technique and approaches.