XVI SCIENTIFIC CONFERENCE and IV SCHOOL OPTICAL FIBRES AND THEIR APPLICATIONS

TEMPERATURE SENSITIVITY OF PHOTONIC CRYSTAL FIBERS INFILTRATED WITH ETHANOL SOLUTION

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ABSTRACT:

In this paper we present a numerical study on the optimization of dispersion of regular lattice photonic crystal fiber infiltrated with water-ethanol mixture. The advantage of such approach comes from stronger than for solid materials dependence of temperature changes on refractive index of liquids. We consider photonic crystal fibers with regular hexagonal lattice with various geometrical and material parameters such as glass type, number of rings of holes, lattice constant and size of core and air holes as well as various concentrations of ethanol solution. For the optimized structure with flat dispersion characteristics we analyze an influence of temperature on dispersion characteristic and zero dispersion wavelength shift of the fundamental mode. Supercontinuum generation in optimized fiber structure is modeled with generalized nonlinear Schrödinger equation.

I. INTRODUCTION

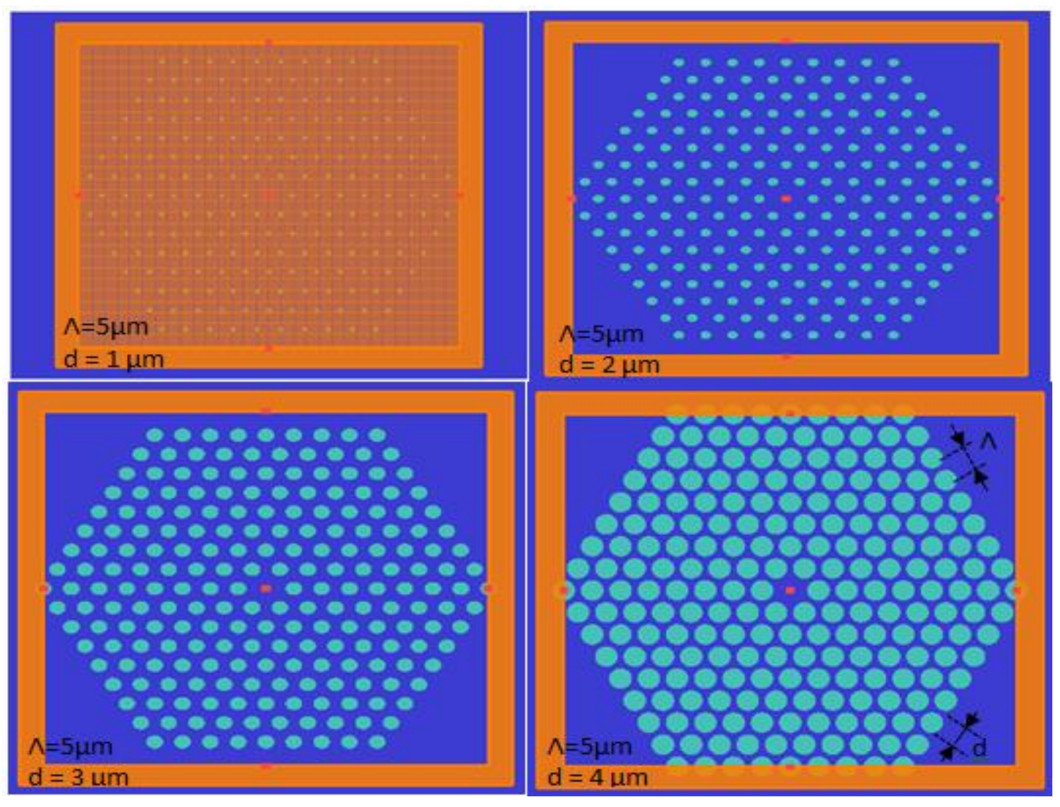
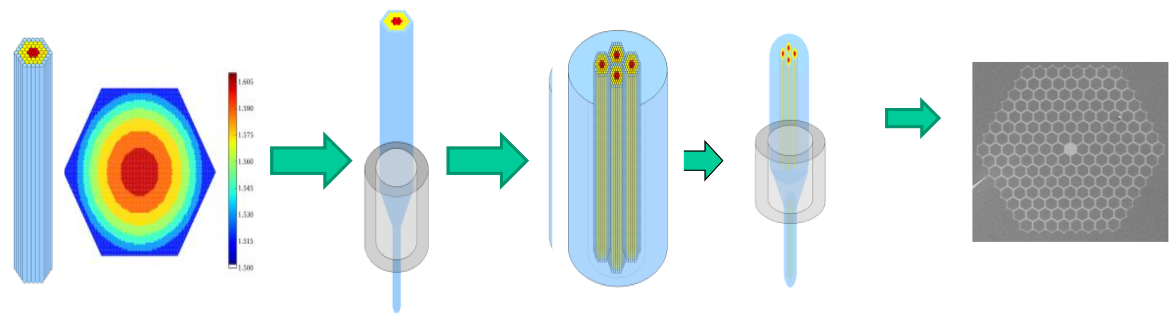


Fig.1.Geometry of analyzed fiber with microstructured cladding with hexagonal lattice for Λ = 5µm and various diameter of air holes d = 1µm, 2µm, 3µm, 4µm.



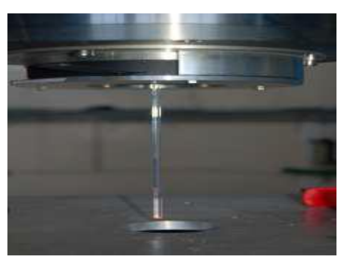


Fig.2. Stack-and-draw fabrication method

II. NUMERICAL ANALYSIS

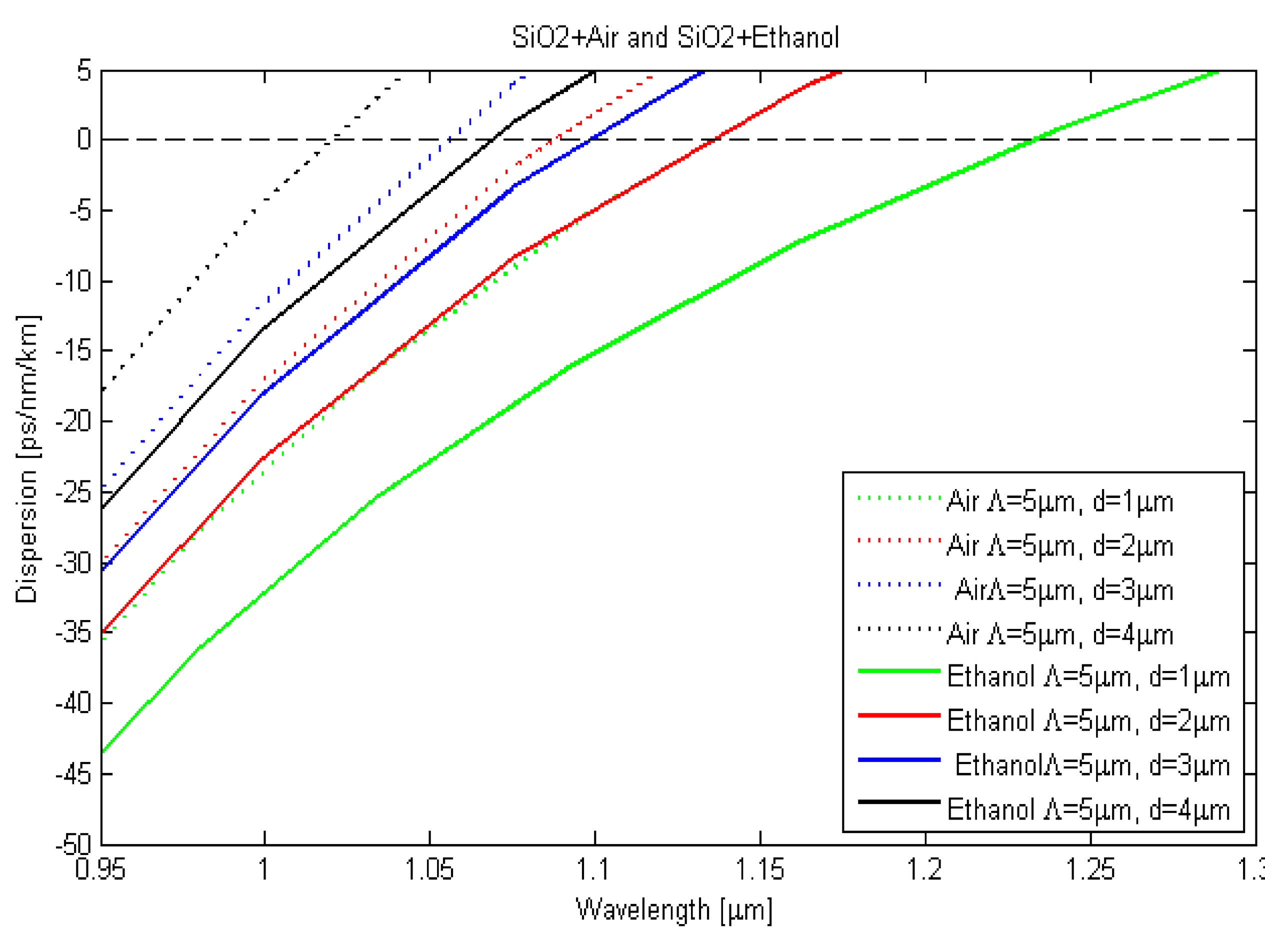


Fig.3. Dispersion properties of microstructured fibers with air holes and infiltrated with ethanol..

Δλ1	Δλ2	Δλ3	Δλ4	max1(Δλ) = Δλ1
0.096	0.052	0.041	0.048	0.096

III. WATER – ETHANOL MIXTURE FOR TUNING OF ZERO DISPERSION WAVELENGTH

- Material dispersion of water and ethanol modelled with Sellmeier equation :

$$n(\lambda)=\sqrt{1+\frac{A_1\lambda^2}{\lambda^2-B_1}+\frac{A_2\lambda^2}{\lambda^2-B_2}}$$

- Formula for determination refractive index of water-ethanol mixture:

$$n_{E_x}n_{W_{100-x}}=\frac{x}{100}n_E+\frac{100-x}{100}n_w$$

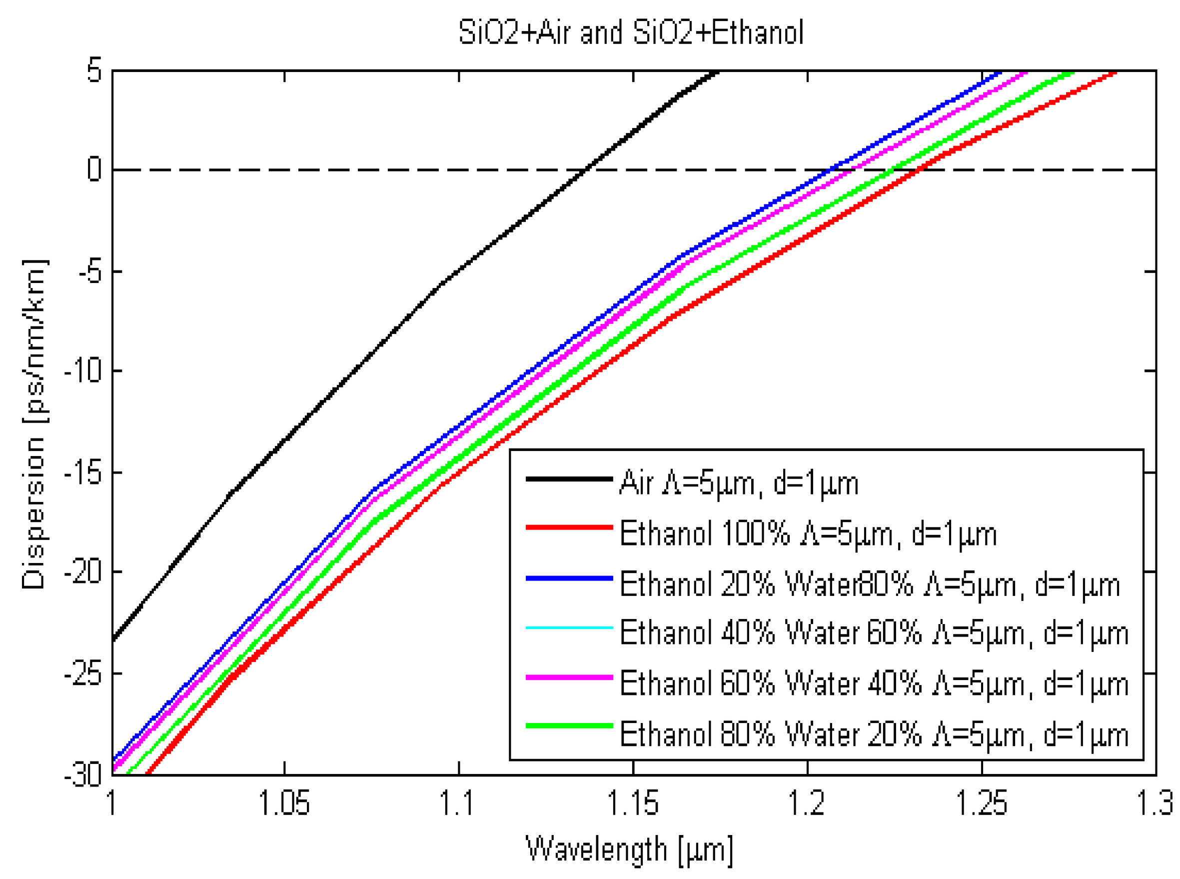


Fig.4. Dispersion properties of the microstructured fiber infiltrated with water-ethanol mixtures.

IV. INFLUENCE OF TEMPERATURE ON ZDW FOR PCF INFILTRATED WITH WATER

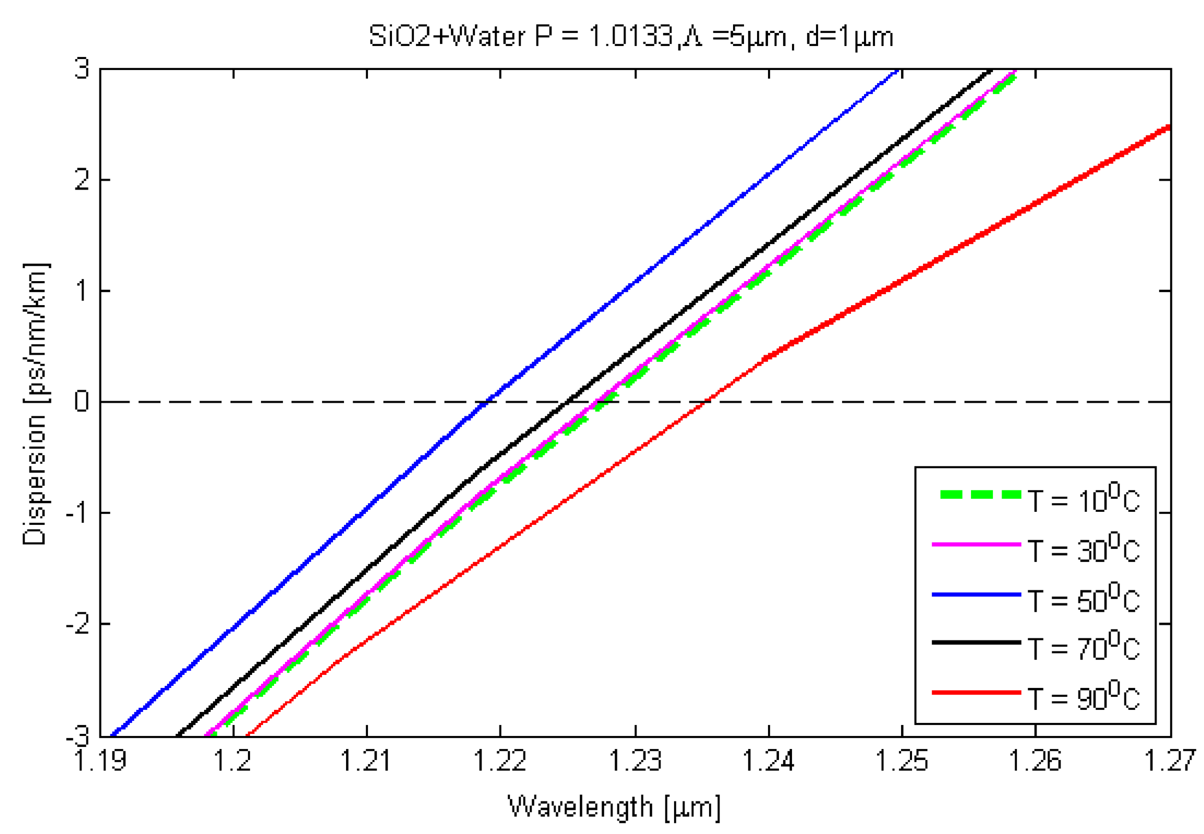


Fig.5. Dispersion properties of the microstructured fiber infiltrated with water.

V. CONCLUSIONS

We have studied and optimized of dispersion of regular lattice photonic crystal fiber infiltrated with water-ethanol mixture. We have analyzed fused silica microstructured fibers with the hexagonal lattice of Λ = 5µm and various diameter of the air holes d = 1µm, 2µm, 3µm, 4µm. Dispersion properties of the PCFs with the photonic cladding infiltrated with water, ethanol and water-ethanol mixtures are analyzed. ZDW can be tuned over 150 nm with the fiber is infiltrated with selected solution. A change of temperature of water in the range 10 – 90 ºC shifts ZDW by 20 nm. Use of water-ethanol mixture with a dedicated proportion allows very fine tuning of ZDW for drawn fiber structure.

VI. REFERENCES

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