Rotation of the Polarization Plane of Light *Via* Use of the DNA-Based Structures for Innovative Medical Devices

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Abstract: It is well known that in the biomedicine the people use sugar meter instruments to test the level of the sugar in the blood. The physical effect activated in these types of the devices is coincided with the mechanism of the rotation of the polarization plane of the light. Generally, in order to operate with an active media responsible for the rotation of the light polarization plane one can use classical ~10% sugar-water solution. *In the current paper* the innovative approach has been shown to apply the DNA-based structures in order to activate the optical effect regarding the rotation of the polarization plane of the light.

Keywords: Nano- and bio-doped composites, dyes, DNA, spectral parameters, optical effects, rotation of the polarization plane of light, correlation with water sugar solution.

1. INTRODUCTION

It should be noticed that different optical effects have been used now to test the materials properties used in the optoelectronics and in the biomedicine. The special accent can be given to the rotation of the polarization plane of light. It should be remarks that the rotation of the plane of polarization of the shear wave is a physical phenomenon consisting in the rotation of the polarization vector of linearly-polarized shear waves around a wave-vector waves passing through an anisotropic media. Basically the effect of the rotation of the polarization plane of the light explained in detail in the following books and papers [1-4], which can be considered in the following materials: quartz, sugar, wine acid, camphor, cinnobar, etc. Some of these structures can show the light polarization rotation effect in the solid state and in the liquid phase, but some of these materials have not shown the effect under the melted conditions.

At present time namely nanostructured materials have been used to realize the different optical and electro-optical features [5, 6]. Recently we have observed the rotation of the polarization plane of the light in the systems based on the noncentrocymmetric dyes solved in the tetrachlorethane solution [7]. The dependences of the rotation angle on dyes concentration have been obtained. The dependence of the angle of the polarization plane rotation on the dyes molecular mass have been established. Moreover, in the next paper [8] the novel dyes soluble in water have been studied to obtain the effect of the rotation of the plane polarization of light. The comparative data for the water sugar solution have been done. The main reason to continue the study noticed above is to find the effect of the light polarization plane rotation namely in the water soluble dyes solutions in order to propose to used them in the biomedicine too. It will be considered as alternative way to apply the results in the area of the sugar meter devises and in the polarizing complicated schemes.

In the current paper the noel aspect is done when the comparative study of the DNA-based systems are investigated to activate the effect of the rotation of the polarization plane of light. The non-toxic DNA-based compounds with small DNA concentration in the solvent have been used. We have observed the effect discussed at the same experimental conditions, which have been applied to treat solution with dyes and sugar.

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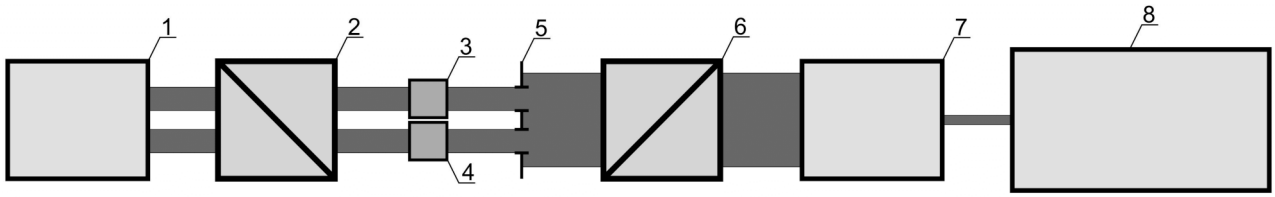

Figure 2: 1 – photodetector, 2 – polarizing prism, 3 – cuvette with the samples, 4 – cuvette with the catalog solvent, 5 – diaphragm, 6 – polarizing prism, 7 – telescope, 8 – He-Ne laser.

2. EXPERIMENTAL DETAILS AND RESULTS DISCUSSED

The general scheme to show the rotation effect is presented in Figure **1**.

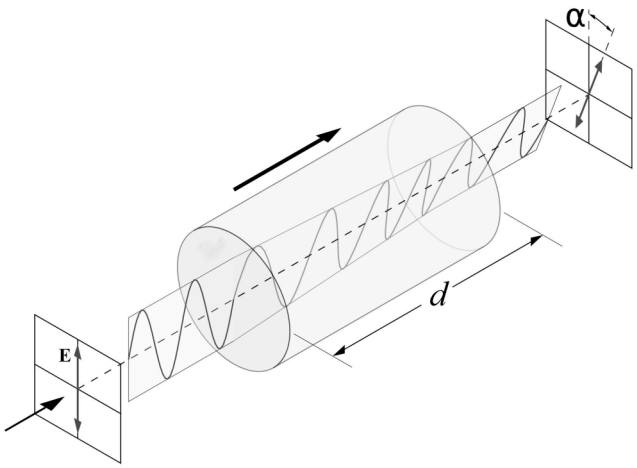

Figure 1: Quality scheme to explain the features of the effect of the rotation of the polarization plane of light.

The experimental scheme to measure the angle of the polarization plane rotation is shown in Figure **2**.

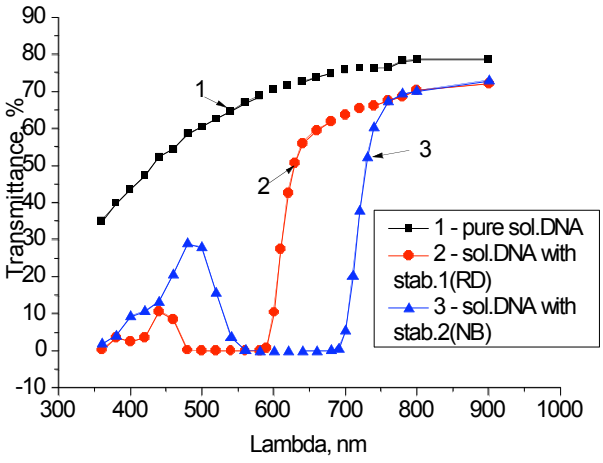

Figure 3: Spectral parameters of the used materials.

The spectral results regarding the DNA and stabilized DNA water solutions are shown in Figure **3**. It should be noticed that the DNA concentration in water solution was approximately of 3g/l. The change of the rotation angle for the solution with different dopants (RD and NB stabilizers with the content of ~4.67%) is connected with the following series: 3-3.8 degrees (pure DNA water solution), 9-11 degrees (DNA with the stabilizer RD), 0 degrees (DNA with the stabilizer NB).

Under the same experimental conditions we have previously obtained that all dye solutions [7, 8] rotate the polarization plane of the light with good advantage, but the angle of the rotation is less than the one established for the DNA-based materials. The results have been the following: the angle of the rotation for the dye ENS-291 is close to 0.12 degrees, the analogous data for the dye of ENS-295 is 0.2 degrees, and the value of the angle of the rotation of the polarization plane of the light for the dye of ENS-102 is 0.25 degrees.

It should be mentioned that under the same experimental conditions (please see Figure **2**) the angle of the rotation of the polarization plane of the light for water sugar solution has been found to close to 0.5 degrees at larger concentration of sugar in water. It should be mentioned that the sugar concentration in water has been ~10% (essentially less than that for DNA water solution), but the thickness of the cuvette of 10mm has been the same.

To summarize, the comparative data of the angle of the rotation value for all studied systems, namely: pure DNA, DNA with stabilizers, dye ENS-291, dye ENS-295, dye ENS-102 and ~10% sugar-water solution are shown in a Table **1**.

Thus, nontoxic DNA-based structures are very effective organic composites to realize the effect of the light polarization plane rotation. Indeed, in future the results should be discussed in details *via* using the

Table 1: Comparative Results of the Obtained Values of the Angle of the Rotation

Sample #	Nature of the Sample	The Rotation Angle Value, °	Ref.
1	Pure DNA water solution	3-3.8	Present
2	DNA with the stabilizer RD	9-11	Present
3	DNA with the stabilizer NB	0	Present
4	ENS-291	0.12	[7,8]
5	ENS-295	0.2	[7,8]
6	ENS-102	0.25	[7,8]
7	Sugar-water solution	0.5	[7,8]

mass spectrometry analysis and etc. experimental technique. Moreover, it should be draw the attention that the DNA-based materials are the good candidate to test the different features of the nano- and bio-doped organic composites. Thus, this local conclusion is coincided with the established of the self-assembling and orientation effect of the DNA in the liquid crystal mesophase shown recently in the paper [9].

3. CONCLUSION

Analyzing the results obtained in the current research one can conclude the following:

1. Instead the insoluble and water soluble dyes solutions the DNA-based materials can be used with good advantage.

2. Instead the water sugar solution the DNA-based materials can be used in the sugar meter and polarizing systems.

3. These nontoxic DNA-based materials have special accent due to the fact that they rotate the polarization plane of the light comparatively with the value close to that which can be established for classical sugar water solutions.

4. The area of the application of the results obtained connected not only with the telecommunications or laser systems, but with the displays and biomedicine too, for example to visualize and test the DNA and human erythrocytes.

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