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FORENSIC ANALYSIS OF COLORED MATERIALS IN THE FIELD OF LOW ENERGIES

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INTRODUCTION

Experimental analysis of colors in the field of low energies was performed by the method of infrared spectrophotometry with Fourier transformation (FT-IR), on a laboratory instrument brand "Thermo Fisher Scientific“, model "Nexus 6700". The examined samples of colored materials were collected during forensic examinations of traces of paint from the places of various criminal events on the territory of the Republic of Serbia, in the period from 1999-2009. years. As it is already known that each color, at certain wave numbers, has characteristic spectrograms (especially in a specific, middle infrared region), in order to obtain a certain law in the behavior of color spectrograms, an experiment was performed. Concrete spectrograms were obtained by recording experimental color samples. It has been shown experimentally that colors in irreversible processes give exponential distributions with different parameters. As the interval of the wave vectors lies in the deep infrared region, it is concluded that the color molecules exchanged low-energy quanta in collisions with each other, which correspond to rotational energy levels or changes in the L-S interaction. The obtained results represent the most objective criterion for the identification of colored materials using experiments in the low - energy region, because the characteristic wavelengths are determined through the superposition of all individual exponential distributions.

EXPERIMENTAL ANALYSIS OF COLORED MATERIALS

The measurement is performed comparatively, by the FT-IR method, which means that two beams of infrared light are passed through the system. One of these beams is the reference beam, which means that its intensity (ie. the number of infrared photons) does not change with the change of wavelength. The number of these reference infrared photons will be denoted by *N(λ)*. The second beam passes through the dye, ie. through the material in which the dye is dissolved, and the measurement shows that the intensity of this beam (ie. the number of infrared photons) changes depending on the wavelength *(λ)*. Irreversible absorption curves occur at different intervals of wavelengths and with different inclinations, which means that the color is nuanced but still has only one effect on infrared photons, ie. to absorb them irreversibly. The registered number represents the number of infrared photons that were not absorbed.

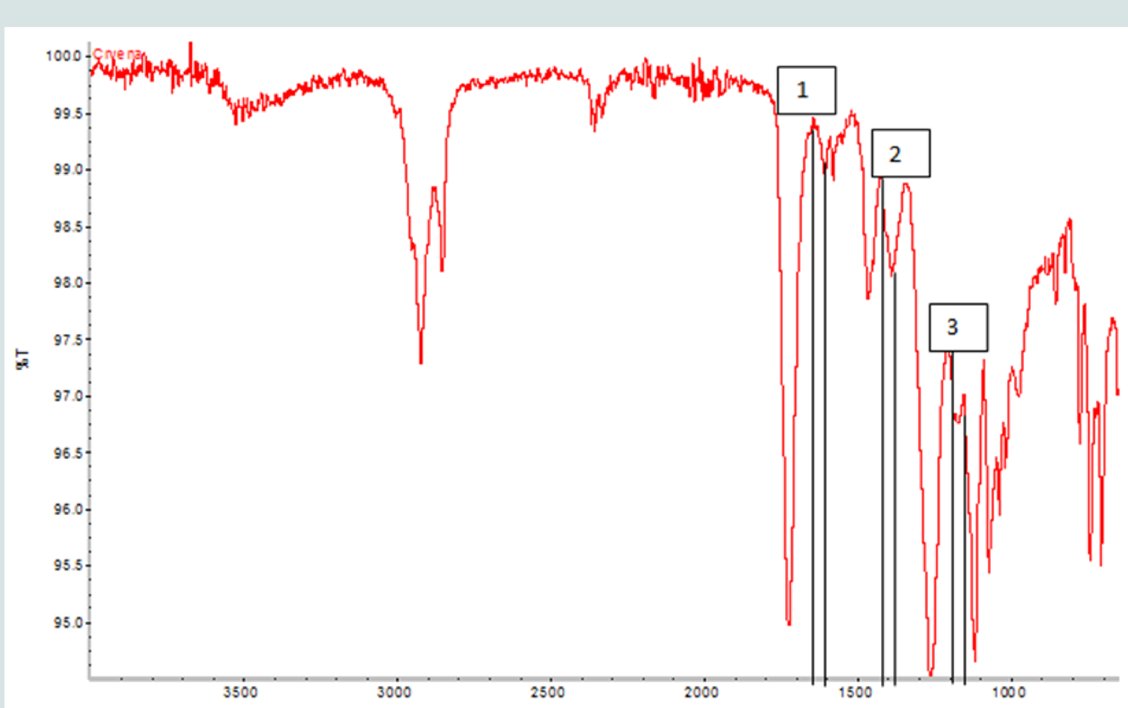

Fig. 1. FT-IR spectrogram of red acrylic car paint in one layer. Numbers 1 - 3, numbered the spectral regions to which the theoretical method was applied

After reading the values from the spectrogram, the corresponding tables (1, 2 and 3) are formed:

Table 1: Values from the ordinate and abscissa for the first region (1) of the spectrogram

K_i [cm^{-1}]	$x_i = -z_i = -(K_{max} - K_i)$ [cm^{-1}]	N_i	$\ln N_i = y_i$
1642,86	-157,14	157,5	5,06
1628,57	-171,43	151,5	5,02
1614,28	-185,71	146,5	4,98
1600,00	-200,00	142,00	4,956

Table 2: Values from the ordinate and abscissa for the first region (2) of the spectrogram

K_i [cm^{-1}]	$x_i = -z_i = -(K_{max} - K_i)$ [cm^{-1}]	N_i	$\ln N_i = y_i$
1428,57	-371,43	141	4,95
1414,28	-385,716	131	4,87
1400,00	-400,00	117,5	4,76
1385,71	-414,287	113	4,73

Table 3: Values from the ordinate and abscissa for the first region (3) of the spectrogram

K_i [cm^{-1}]	$x_i = -z_i = -(K_{max} - K_i)$ [cm^{-1}]	N_i	$\ln N_i = y_i$
1214,28	-585,72	94	4,54
1200,00	-600,00	80	4,38
1185,71	-614,29	74	4,30
1171,43	-628,58	72	4,27

STATISTICAL PROCESSING OF RESULTS OF EXPERIMENTAL ANALYSIS OF COLORED MATERIALS

The obtained coefficients of directions in the sample of red acrylic car paint on microscopic glass are:

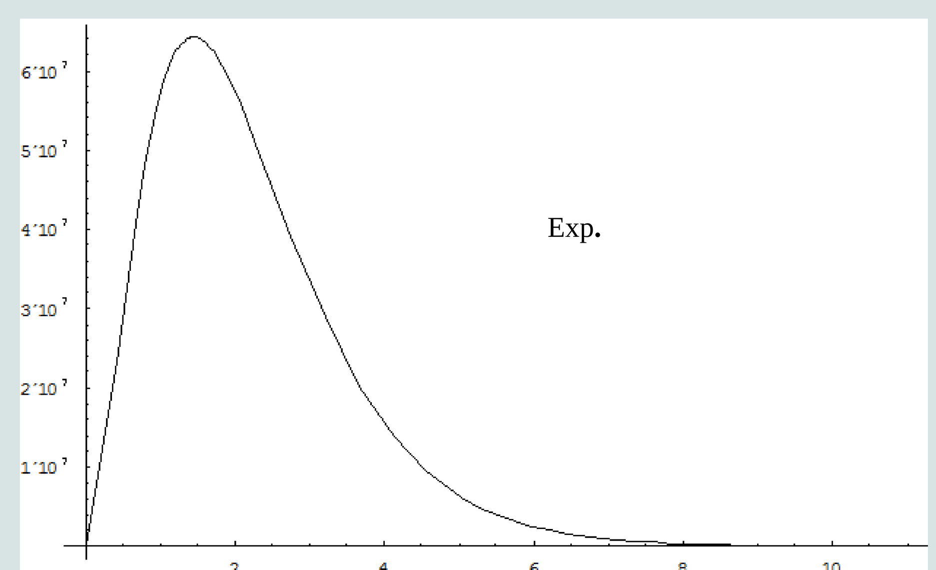

Fig 2. Composite curve formed on the basis of experimental results

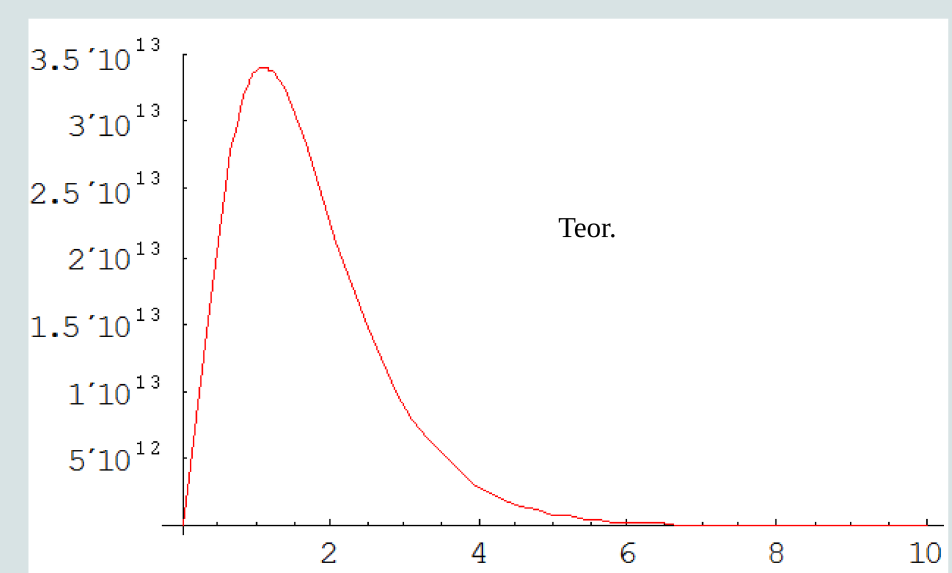

Fig 3. Composite curve formed on the basis of theoretical results

After comparing the experimental curve with the theoretical one, an exceptional agreement is found, which is shown in Fig. 4.

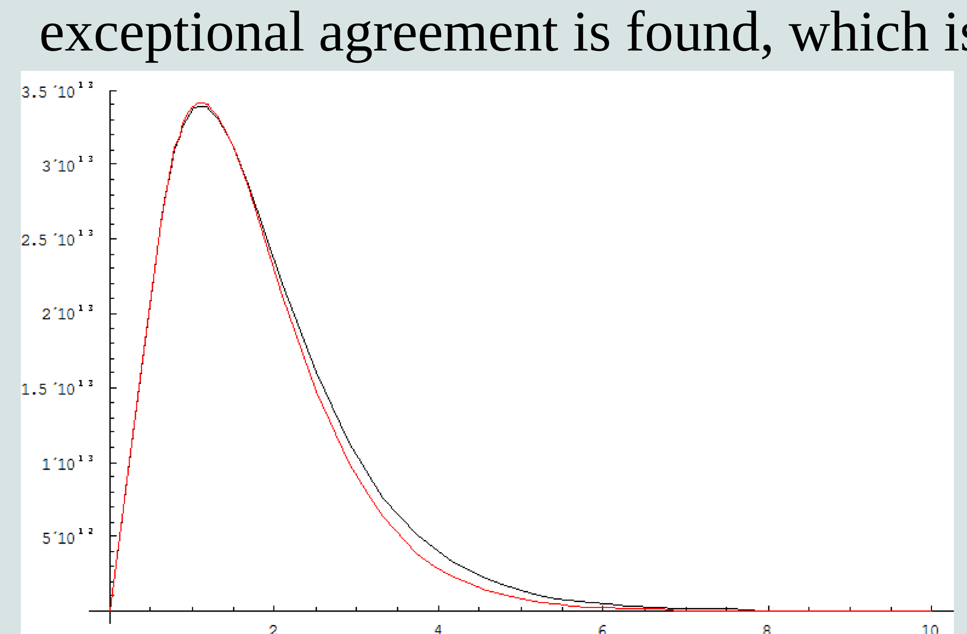

Fig. 4. Comparison of composite curves: experimental and theoretical

$$D_n(\lambda) = \left[\frac{e^{-\theta_1 \lambda}}{(\theta_2-\theta_1)(\theta_3-\theta_1)\cdots(\theta_n-\theta_1)} + \frac{e^{-\theta_2 \lambda}}{(\theta_1-\theta_2)(\theta_3-\theta_2)\cdots(\theta_n-\theta_2)} + \frac{e^{-\theta_3 \lambda}}{(\theta_1-\theta_3)(\theta_2-\theta_3)\cdots(\theta_n-\theta_3)} + \frac{e^{-\theta_n \lambda}}{(\theta_1-\theta_n)(\theta_2-\theta_n)\cdots(\theta_{n-1}-\theta_n)} \right] \prod_{\mu=1}^{\lambda} N_\mu$$

CONCLUSION

In irreversible processes, color molecules mainly absorb energy during collisions. The value of λm can serve as the most realistic criterion for identifying a "suspicious" color in a crime. The most probable participant in the criminal offense, where the tort requires color testing, is the one whose λm in the described experiments is closest to the theoretically obtained values.

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