Double image with ceramic colors in the process of infrared painting

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Abstract: - Expanded spectrograms of pigment light absorption and inks for coloring ceramics are being presented in this article. The experimental part of the paper covers two spectral areas: Visual "V" and the first part of the near infrared spectrum "Z". The values of light absorption at 1000 nm are being assigned to each dye. New experiences are dyes with metallic components: silver and gold. Those colors have a light tone but they intensively absorb NIR light. This is a new experience in painting double, invisible and image information. A spectral description of the dye and the numerical value in Z position is a new experience of connecting science and visual arts. Those colors are new evidence about a absence of any kind of connection, that is, a absence of correlation of measuring values of light absorption in the visual domain and near infrared radiation. Nada Žiljak's art is being presented in "Sveti Ivan Zelina" gallery where the newly developed cameras with a few different filters and assigned blockages with which visual fine art is being detected with dual hidden graphics are being set up.

Key-Words: Double image, ceramic dye spectrum, near infrared, infrared painting, NIR cameras

1 Introduction

The dyes have been studied as digital information in order to develop new algorithms for managing inks and toners in the printing reproduction in two spectral areas [1]. The research has been focused on creating double image information, two images on the same spot that are being independently recorded with a visual and infrared photo camera. Safety IRAREDESIGN® print has been tested and applied to large circulations in offset technology on newspaper paper [2].

The invisible image for one out of two light areas enables the creation of two images on the same spot. The first works of hiding an image have been developed for document for the purpose of improving security of valuable papers. Infrared selective coloring is being applied on banknotes but not for the topic of infrared hiding [3].

Light absorption of a matter in the area between 400 and 1000 nm is being observed in this paper. Light absorption measurements are being conducted with forensic instruments that in that area select the light in a dozen blockages [4]. The forensic instruments are the initiators of the idea for invisible pictures design, creating new painting, new IRD procedure, new security graphics. The extension of the idea of double hidden information called INFRAREDESIGN® has been applied to transparent packaging [5]. The information with "infrared dyes" has been expanded to "security print" of clothes made from army uniform. A new technology of hiding information and development of a double image with textile dyes has been introduced [6].

Abbreviations "V" and "Z" that are being used in different ways of describing colors and dyes have been introduced into the technology of IRD print, dye mixing and presentation of a hidden image. V; that pertains to the visual light area from 400 to 700 nm and Z; that measures light absorption in NIR area in the wavelength

at 1000 nm. The connection of two kinds of dyes is being described by this example: V dye absorbs the light only in the area between 400 and 700 nm.

2 Art ceramics dyes in visual and infrared spectrum

Dyes for art painting offer a great diversity of colors. Each dye has its Z values of absorption in near infrared spectrum. This property is being used by the artists (Nada Žiljak, Dijana Nazor) for creating a personal art duality on canvas. Tones of new, unexplored colors are being developed by mutual mixing of different dyes but at the same time respecting their properties of appearing in two spectra. A hidden image information as a dual image is being presented in this article and it has been set on a ceramic surface.

Colors for art painting on ceramics shown in Fig 1 have been recorded with a double VZ camera in visual RGB spectrum and in NIR spectrum with a blockage at 1000 nm. The first nine colors are the manufacturer's pure colors. Green, red, silver, white and blue (ultramarine). In the second row there are black, gold, cyan, yellow and a mix of cyan and black (50%, 50%).

Fig.1a, A photograph of ceramic dyes in visual spectrum

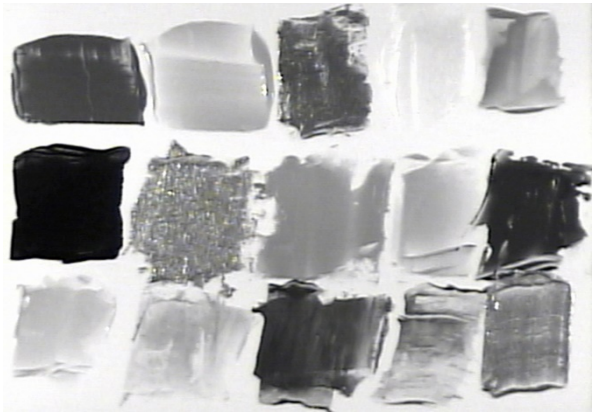

Fig.1b, A photograph of ceramic dyes in NIR (1000 nm) spectrum

Each dye is being assigned value Z (table 1) that represents the information about the level of appearing in NIR-Z. Photographing with a duality is an innovation that protects the author and the picture's collector. It is vital information for the artist when they are performing the hidden image separately for the visual and the NIR spectrum value Z covering is the darkness that has been registered by the NIR camera with a blockage at 900 nm. This is being registered by the machines for banknote (checking in banks), night IR camera on the street, video recorder in the "night shut" mode, binoculars on military or hunting rifles. NIR – Z photo cameras are being set on contrast. Absorbance with a value 0.2 is being set to information of total 100% covering.

Table 1, Numeric values of 9 colors and dyes

Colour	L*a*b	Z % caver.	Absorbance
Dark green 068	41, -30, 12	71	0.140
Cherry red 125	38, 56, 36	29	0.032
Met. silver 782	78, 0, 3	77	0.120
White 070	81, 0, 3,	5	0.014
Ultramar. 055	30, 16, -53	55	0.050
Black 073	8, 2, 0	96	0.188
met. gold 784	70, 5, 39	50	0.090
Cyan 056	47, -14, -29	50	0.055
Yellow 021	62, 22, 6	50	0.037

Value "absorbance" (as) is being registered by a forensic device [4]. Values "Z" and "as" at 900 nm are in high correlation. Absorbance values in the visual area (400 to 700 nm) with

absorbance values at 900 nm do not have correlation. This difference in light absorption properties and absence of correlation was the beginning of the idea of creating a hidden, invisible, double image with ceramics dyes.

The Collection of dyes for art ceramics has colors for achieving special effects. We are singling out colors called “gold”, “silver” that act in an extreme way in IRD technology for emphasizing lighter tones. Graphics with those colors cannot be reproduced for paper book monographic editions, just with printing process dyes; cyan, magenta, yellow and black.

The silver color is visually almost white (the third one in the first row). It strongly absorbs NIR light. Its “as” value is 0,12 and it is being manifested as a dark grey color in NIR photography. The same effect of an “inverse response” is being achieved with “silver dyes” in a printing technique serigraphy. Colors with gold and silver metallic characteristics are ideal in security graphics. They act unpredictably in the infrared area of observation. By adding such dyes to the mixes with other dyes, printers can protect themselves from other people forging their “secret” craft work.

In the third row (Fig 1) are the mixings of different contents of dyes from the first and the second row. The painters are given the option to develop dye recipes and to achieve new effects in their desire to individualize their art work. The first color in the third row is a mix of yellow and red. This color is being poorly absorbed in Z spectrum because it consists of dyes with the same Z characteristics. The second color (green) in the third row is a mix of yellow and blue (the fifth color from the first row) that poorly absorb in Z spectrum. This green color has the same color tone (in V spectrum) as the green color in the first row. But, their power of infrared spectrum absorption is very different. Those are “green tone twins” dyes: equal in the visual and different in the NIR spectrum. The fifth color in the third row consists of red and gold. Such shade of red color has a positive value and it is a twin of the red color from the first row.

Each dye has its own light absorption value at 900 nm. This information is a starting point for creating a hidden image, image for infrared cameras. Regardless the intentional INFRARED ART painting, each piece of art work contains an image that can be observed with a NIR camera. Those are “opaque layers without any sense”. In the future, the painters are going to use the knowledge about light absorption in different light areas and paint according to the new methods of “parallel painting” that is being developed at our University.

In this article we are presenting the results of a spectral analysis of art ceramics dyes. Absorption spectra measured in continuity from 400 to 900 nm for dyes that are being applied to painting of ceramic objects are being shown. Visual V and NIR (Z) absorption spectra of ceramic inks were measured in the range from 400 to 900 nm.

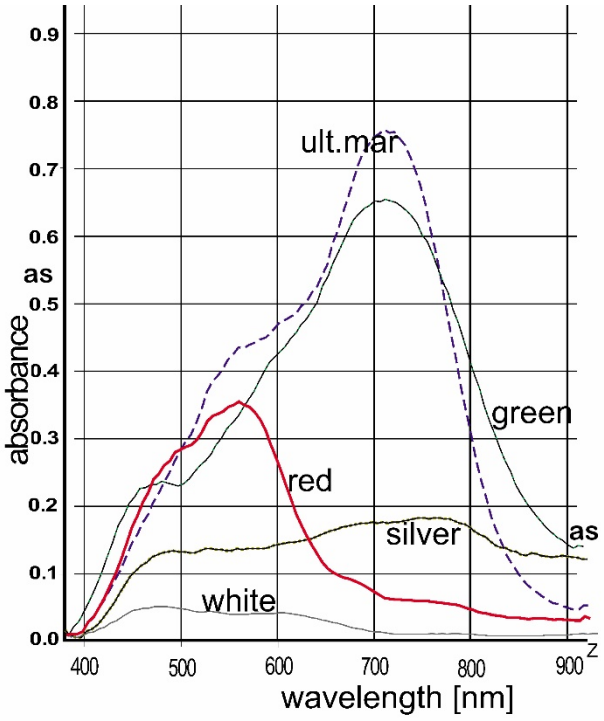

Fig 2a, Dyes spectrum, row 1

3 Ceramic inks’ spectrum measuring

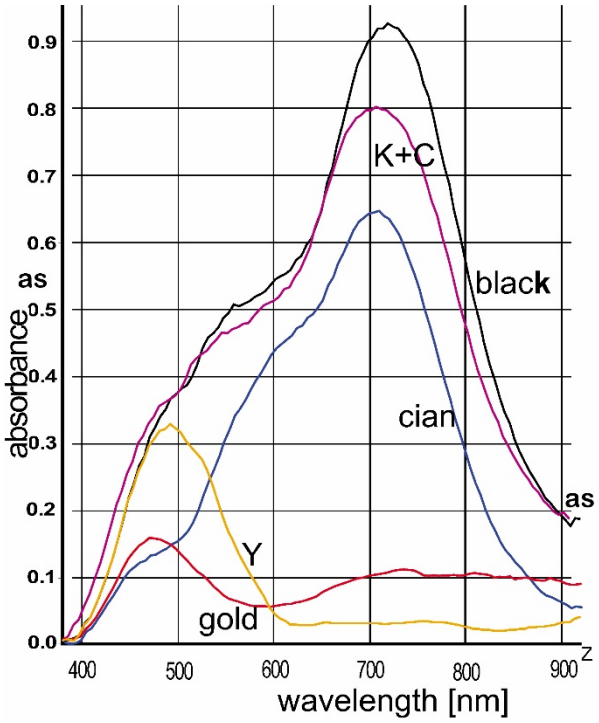

Fig 2b, Dye spectra in the second row

The absorption of a green ink has two maximums at 530 and 600 nm. This green color most probably consists of (remark to the color manufacturer) cyan and yellow colors that have their own separated maximums.
Figure 2 shows spectrograms from the second row of dyes in Figure 1. Those are black, gold, blue and ocher color. The fifth color is a mix of blue color (50%) with an addition (50%) of black color (BK). The yellow ink maximally absorbs radiation at 420 nm. Gold ink has two maximums. Cyan color has a knee at 660 nm.

4 Infrared painting with ceramic colorsInfrared painting with ceramic colors

Theory and application of INFRAREDESIGN® are being observed with two recording cameras, or two photographic cameras, or with security cameras situated on streets, in banks, as expanded observation at night (7). Near infrared spectrum is being observed in its initial area in the range from 750 to 1000 nm. This area is split into two parts. The first part, marked as Z1 is a transition area from the visual to the infrared spectrum, is being separated because it is a mixture that we are blocking on purpose. Cameras for observing effects of IRD® printing procedure have been set to the area of light at 1000 nm (Z) (8).

Fig. 3, Masks with the hidden silhouette of Dubrovnik, V (RGB)Figure 3 Masks with the hidden silhouette of Dubrovnik, V (RGB)

Fig. 4 a, Masks Dubrovnik, 475 nm

Masks in Figure 4 have been photographed with four cameras: visual and blockages at 475, 695 nm and 850 nm. The first blockage infiltrates the yellow color (560 nm). Even the smallest absence of one part from the visual spectrum disrupts the hiding of Z image that is slightly looming. The silhouette of the City of Dubrovnik appears significantly in the following light blockages: 690 nm where the red color disappears. The complete blockage of RGB visual components of our eye is being shown with a blockage at 850 nm. No trace are seen of the masks

from the visual spectrum. Only the drawing remains, the graphic of the city of Dubrovnik.

Fig. 4 b, Masks Dubrovnik, 695 nm

Fig. 4 c, Masks Dubrovnik, 850 nm

When working in the field of forensics, it is recommended for the art work to be recorded with eight light blockages. This is a procedure that is going to protect the author, the collector, the gallerists and the museum. Multiple VZ recordings of the art work guarantee the authenticity of that art work when verifying originality.

Fig. 5a, Ceramics, Nada's painting in two spectra
Spectral analysis and photographing with blockages are going to provide the painters with more information about the dye diversity considering the response in the visual and in the NIR spectrum. Painter Nada Žiljak paints a "graphic with sense". Separate drawing for a NIR observation. Separate drawing for a naked eye observation.
Inventive movement "INFRARED painting" is using the knowledge about the property of dye light absorption for ceramic art. The painter mixes dyes with the intention of having two images for two different light blockages on ceramics. The superior intimacy, extreme message, hidden information, extreme eroticism is not going to be visible to the naked eye.

Fig. 5b, (mask, 1000 nm)

Generaly, infrared painting have been given as an animation created after recording in 12 light blockages.

Fig. 6, Picture with a blockage at 700 nm with the address to animation.
http://jana.ziljak.hr/AnimacijaFigure4.mp4

The title of the painting (Masked dance) tells us about the riddle, hidden information, and the reason for creating a new piece of art work. Only the author knows why she connected the landscape with the masks, abstract surface with lustful dance, seemingly so unrelated V and Z images. Colors, materials and contents meet in such art work. All together they talk about a creative act, reasons and secrets of the artist.

Two states, duo paintings, can be in a great dependence, and they can be, seemingly, in complete opposition. Calm see, idyll, and with a storm in one's soul, for example. Love, masks, fantasies and a great range of experiences. The author is left with a difficult task: to connect the duo state with the work's title. The title now becomes an important element of the painting more than ever. It reveals the link between two independent states of the art work in a way that has been imagined by the artist.

5 Techniques and Technologies in new art creations

Colors for infrared painting are being tested in FotoSoft laboratory where a software for managing print and recording with multi filter cameras has been developed. Reproductions with VZ properties are being created for all the art works. Recording and description of nature, computer graphics and art works is being approached in a new way. In the laboratory for INR painting graphic preparations for catalogues for VZ exhibitions are being developed, considering that even in a reproduction a double image is being materialized. It was an incentive and a reason to develop a new graphic method of connecting two photographs for printing with process dyes [7].

Fig. 7a, NIR laboratory (RGB)

All the materials have their own dyes whose application and selection gets a new meaning. Together they enable a wide range of author painting creating a new IRArt approach to the art work. Nada Žiljak exhibited the first "double paintings" in Sv. I. Zelina Gallery and Sv. Kršovan Gallery in Šibenik.

Fig. 7b, NIR laboratory (NIR –Z)

The painter Nada Žiljak mixes colors according to their response in NIR spectrum. Z value is being consulted to each dye, and that is information about the light absorption at 1000 nm. Art painting is reaching for new ways of experiencing colors and mixing dyes. Painters, graphic designers and artists in multimedia field are aware of the possibilities of using light properties outside the range of the naked

human eye, and by that of creating new painting. This new "INFRARED painting" art has been expanded to coloring ceramics. The artist is using spectroscopy, which is something completely new for the painters. This is a tool for achieving a hidden, double, invisible image. They are using "Z glasses" that have been specially designed for painters and graphic designers and that enable simultaneous observation of the state of art work in infrared spectrum and observation of the painting intended for the naked eye. Never before until now the artist could have created an object of their fantasy in a better way, by hiding their intimate art work in some other painting. They are using light properties, properties of dye matter in a way that opened them a new way of expressing themselves.

6 Conclusion

Spectrograms of inks, pigments and colorants for ceramics are necessary for managing colors and dyes outside the range of our naked eye. The process of mixing dyes and the act of painting itself shall be observed through NIR cameras with different light filters, in order to create a double, hidden graphics inside a visual color painting.

Each dye is being carefully observed in two spectra, with a few cameras with different light blockages. The artist Nada Žiljak is trying to separate two images as much as possible. She is using NIR information on dyes in order to develop new dyes with strictly: either single or double absorption properties. In this way the new painting that provides a security component against falsifying and bad moves in the restoration technique is going to be developed. A new possibility of self-expression is presented to the artists where they will be able to hide their intimacy, far from the eyes of regular observers. Future museums are going to be equipped for a multimedia way of studying, observing art works in different spectral areas.

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