OXIDATION TECHNOLOGY AS A DECORATIVE COATING IN THE ARTISTIC TREATMENT OF METAL.

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Abstract. The task set for this paper is view the process of oxidation on high temperatures during the creation of products of art. The result of the author's analysis shows that said technique could be used in artistic purposes, showcasing the advantages and disadvantages of said method. Key words: oxidized steel, handmade jewellery.

Oxidation of high temperatures is an unfairly forgotten technology for artistic surfaces. The oxidized film, depending on the heating temperatures can give a varied colour range going from straw yellow to dark-blue, which can be called the discoloration colours.

Being one of the most affordable methods of processing, the oxidation of metals is widely used, but rarely in artistic purposes. The discoloration colours were often used to indicate the temperature of iron and steel upon heating during heat treatment. It was also used to judge on the temperature of heat of steel shavings, and thus the chisel during whetting, boring and milling.

The use of this technology in the creation of jewellery permits to achieve some interesting colour results. Using different temperatures one can achieve a variety of colours and textures, which will be appealing to the consumers. The creation of patterned, highly artistic jewellery with the aid of oxidation technology can revive and develop this type of treatment, which can stimulate a new milestone in the development of this technology and it's perfection. Reviewing the contemporary objects that have been treated with said technology, we should point out that it is used to treat the blades by masters in Zlatoust (pic.1).

Pic. 1- Knife blade decorated using the method of high temperature oxidation.
Work of master – Emchenko from Zlatoust.

During the creation of jewellery, steel can be used as the main element and as a decorative element of any piece of jewellery, as long as the price of the base and the artistic part are equal. For example one might add this decorative elements in pendants, earrings, brooches made of metal. Seeing the tendency of contemporary consumers to acquire unique pieces, the creation of jewellery using this technology can be of high interest to jewellers. The technology is so economical financially, that they will be only restricted by the limits of their skill.

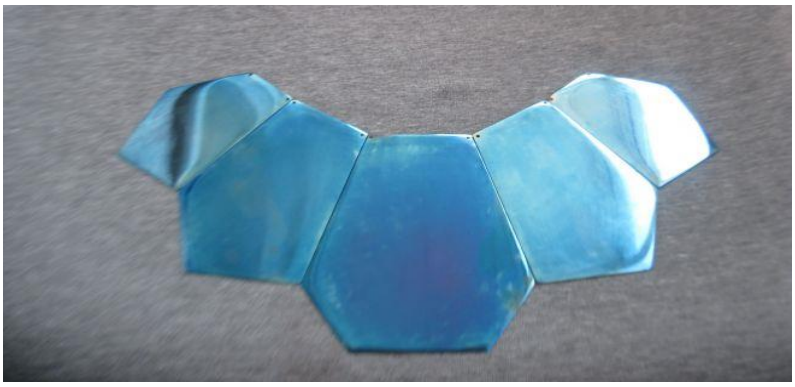
At this stage of the work of most interest was the creation of a handmade necklace, which could showcase the wide colour range of the oxidized films. This became the main goal of this work.

To achieve said goal were chosen a few tasks:

1. Creating a card of discoloration colours for the muffle furnace;
2. Creating a sketch of the necklace;
3. Choice of the optimal method to create the base;

4. Creation of prototypes of the details of the necklace, test of the strength of the film after constant wear.

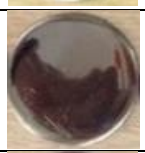
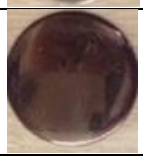
When creating a piece of jewellery one should consider the fact, that the surface of th steel can be prepped by various means for coating. Depending on it we can achieve a mate, shiny or glossy finish, depending on the prepping: rough grinding, soft grinding and polishing (picture 2).



Pic. 2 Glossy oxidation.

The colour range of the film is quite specific, based of the transition from yellow to purple, then to blue. The temperature used in the process plays the main role in this. Yet, one should not forget the effects of time and of the gas environment: under a relatively long exposure the colours start to alternate. The dependence of colour and temperature can be seen in the Chart 1, in which the time of exposure in the furnace was of 15 minutes for all the samples. For the samples was used a plate of the mark Ct 3 State Standard 380-2005 with a thickness of 2 mm. Since it's less susceptible to grinding and polishing that other types of steel, yet it retains the processed surface and looks better.

Chart1 Dependability of colour and temperature

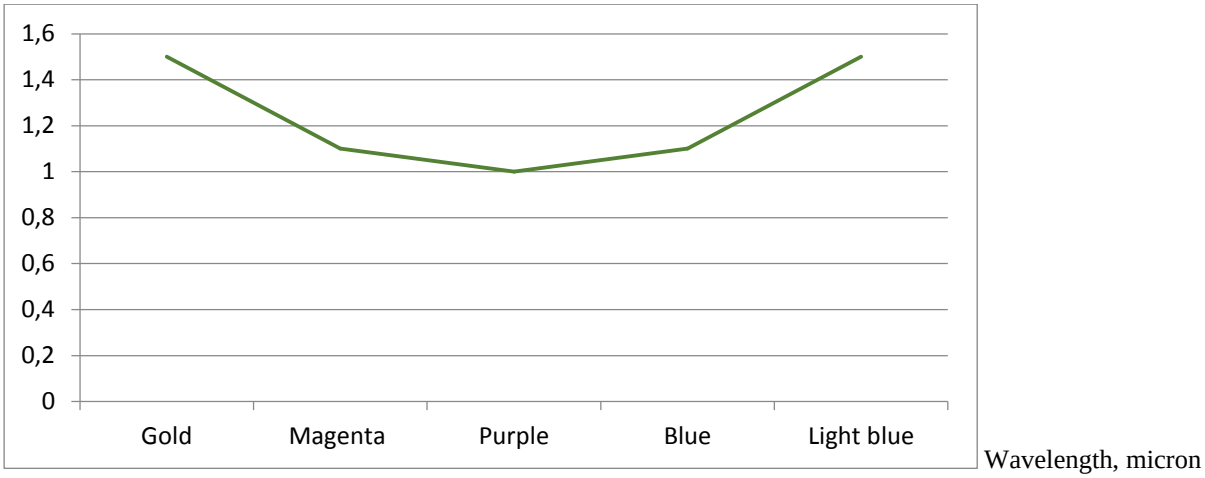
Temperature, °C	Name of the colour	Picture		Temperature, °C	Name of the colour	Picture
250	Light yellow			320	Purple	
260	Yellow			345	Light blue	
280	Light brown			365	Blue	
300	Brown			385	Dark blue	

The discoloration of the surface, achieved with the oxidation method is the result of wave interference in thin films. The dependability of colour (wavelength) of the thickness of the oxidised film is shown in formula 1 and picture 3. The colour range depends on the temperature and time of exposure in the furnace.

Formula 1 Dependability of colour and thickness of the oxidised film

$$d = \frac{\lambda}{4},$$

where d-thickness of the oxidised film, λ-wavelength



Pic.3 The dependence of the colour on the film thickness.

The technology of fabrication:

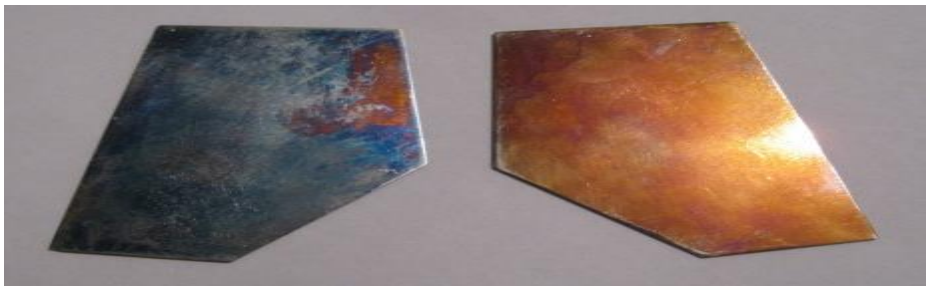
1. Using the colour chart and the chosen dimensions of the product, was drawn an oriental pattern and formed the design of the product.
2. The next step was the choice of the means to obtain details for the necklace. The optimal choice was laser cut, since it will not cause warping, would provide a smooth edge and an exact size.
3. Then we process the details: grind rough and smooth, polish with GOI polishing paste and Vaseline, degrease and corrode. The most important step is degreasing, since it's the factor on which depends the coating uniformity and the presence of defects. It is best to first degrease with tar soap (through experimentation it was come to be proven the best way to clean the details from GOI polishing paste), then with acetone and right before putting them in the furnace with industrial alcohol.
4. We maintain the details in the furnace at the required temperature the proper amount of time.
5. At last, we process the plates with a boron-machine, to create the pattern and reheat the details. If placed by hand on small parts the pattern isn't smooth enough, so it is best to use laser engraving: for this it is best to CG the pattern in vector format and engraved it with a laser. This will make the pattern more accurate, but will take away the individuality of the piece.

When obtaining the first samples some mistakes were made, such as – no nippers were used to transport the details after degreasing, thus producing defects in the coating - stains and unevenness of colour (pic.4). Besides, the furnace used had a gradient of temperatures, which gave supplementary unevenness in the colour of the coating, shown in the gradual transfer from dark to light shades.

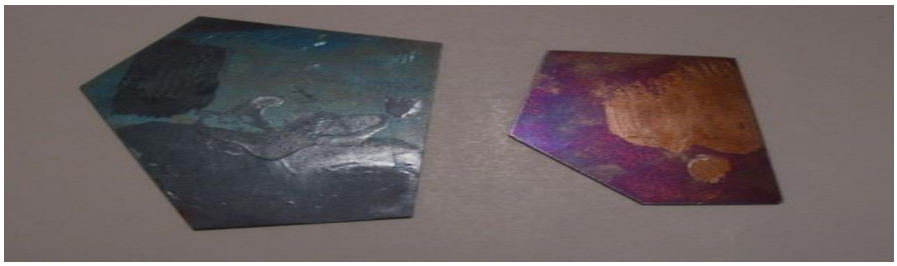
But despite this state of the coating it can be used to create abstract patterns, such as cosmos or starry sky.

The samples were also tested to see the durability of the coating, which showed that it wasn't durable enough. Yet, it is impossible to use a protective coating, since the colour depends on the thickness of the coating (formula 1) and the supplementary protective coat distorts the colours, making them duller. The blue colour becomes

muddy-blue after the addition of lacquer; the purple acquires a dull yellow tint (pic.5). The brand of the lacquer plays no part in this process.



Pic.4 Defects of oxidation



Pic. 5 Defects in the coating

The necklace created (pic.6), took in account all the details of the technology and features of assembly.

Pic. 6 Prototype necklace, obtained by thermal oxidation

Summarizing the work that has been done, we can say that said technology is on the stage of development and the achieved coating is still experimental. Yet the coating has good decorative features and goes on stable, if all the steps of the technological process are preserved. During our study we obtained an experimental prototype necklace (pic.6), which will be the example for future creations, extending the usage of this technology in the fabrication of jewellery.

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