Application of Metal Composite Materials in Hot Encaustic

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Abstract. This paper studies the application methods and skills of adding metal materials (powder, crumb, fiber and solution) into traditional hot encaustic techniques, so as to explore the comprehensive application of various materials and media and enrich artistic expression techniques. In this paper, the feasibility of using metal materials in hot encaustic is affirmed. Individualization of artistic exploration means that artists must improve their artistic language according to their own knowledge and experience structure. In the process of exploring the language of hot encaustic, I try hard to integrate my expression techniques into the picture making mode, so as to achieve a more complete research effect and accumulate experience for future hot encaustic creation.

1. Introduction
From ancient times, humans used mud and charcoal to leave fingerprints and animal images on rock walls; In the middle ages, Danpela technique was developed by painting on wooden boards with egg whites and pigments; In the 15th century, Jan Van Eyck used linseed oil to blend pigments to perfect oil painting techniques. The history of western painting art is also a history of the development of materials and media. With the development of modern science and technology, painting materials and media emerge in endlessly. These technological advances not only broaden artists' creative techniques, enhance their visual effects, and facilitate artists to express their creative ideas more directly, but also inspire the possibility of exploring new painting materials and media.

Material is not only a direct component of the picture, but also a technical carrier to express the author's inner thoughts. Therefore, artists will look for unique technical media to express their personal ideas. The relationship between material technique and painting complements each other. The former is both a method and a content, which should be considered in the process of creation. The maturity of an artist's personal language is largely reflected in the rationality of this combination.

Encaustic is an ancient and special language medium, which needs to convey the basic content carried by the medium—the artist's concept, emotion and artistic accomplishment. The evolution of art depends on this basic content, so that a material technique can show different features in different periods. As an artist of encaustic, it is the foundation of artistic creation to be familiar with the characteristics of materials and master their application techniques.

2. The development course of hot encaustic art
From the 5th century BC to the 9th century BC, a painting technique called encaustic was popular in Greece and Egypt of the ancient Roman Empire, represented by portraits found in Fayoum, Egypt in 1887. Fayoum portrait is a portrait of the deceased drawn with wood or linen as the base and beeswax as the toning medium. After completion, it is embedded on the mummy to replace the mask used by the
early mummy. Painters use melted beeswax and resin as toning media, blend natural minerals and plant pigments, and use heated spatula, brush and other tools to draw on wooden boards. After completion, the colors remain unchanged for a long time, even after one or two thousand years, they are still as bright as new. Because the palette, pigment box and even drawing board need to be heated in the whole drawing process, it is called hot encaustic method, which can be called the earliest easel painting art, and the cold encaustic developed from it is the source of Danpela's painting technique in the early Byzantine period. Although hot encaustic has the advantages of waterproof, anticorrosion, stability and durability, due to the limitations of materials and tools, it was gradually replaced by Danpela and oil paintings in the Middle Ages and the Renaissance after that. In the 18th century, artists wanted to solve the technical problem that the color of frescoes remained unchanged when they were wet, so their eyes turned to beeswax again. This process focused on the application of frescoes at first, and at the same time began the exploration and development of encaustic painting on shelves.

In the 20th century, artists' exploration of expression forms has prompted the former single artistic context to gradually show a diversified tendency, and the use of material media has largely become the artist's direct expression language. In this context, beeswax, an ancient material, has become the choice of many artists in material practice because of its many characteristics. Its use can achieve two functions: one is the practical significance of the material itself, and the other is the special effect of the material.

3. A study of hot encaustic technique

3.1. Research experiment of materials and techniques
In the process of exploring the hot encaustic technique, I learned from the technique of German artist Diak, and made wax by heating and melting beeswax, rosin, linseed oil and turpentine in proportion, and then blended iron oxide toner or oil painting pigment with wax. When painting, the wax color is scraped on the picture with a scraper, melted and fixed on the picture by heating with a flamethrower, and painted with a brush and scraper while it is hot. In this process, the application of metal powder, debris and metal solution is combined until the ideal effect is achieved.

1. Wax material

| Material State | Material | Proportioning method | I  | II  | III | IV  | V  |
|----------------|----------|----------------------|----|-----|-----|-----|----|
|                | Beeswax  |                      | 10 | 10  | 10  | 10  | 10 |
|                | Rosin    | 2                    | 4  | 10  | 16  | 20  |
|                | Linseed oil |                  | 2  | 2   | 3   | 4   | 5  |
|                | Turpentine |                   | 1  | 1   | 1   | 1   | 1  |
| Drying speed   | Faster    | Faster              | Faster | Faster | Faster |
| Cohesive force | General   | General             | General | Better | Better |
| Flexibility    | General   | General             | Better | Good | Good |
| Toughness      | Strong    | Strong              | Strong | Strong | Strong |

Through experiments, it is found that the change of drying speed and toughness of wax materials with different proportions is always small, but the change of adhesion and flexibility is great, so the proportions in the fourth and fifth columns of the above figure are ideal, and the prepared wax materials are solid paste after cooling, which can be easily scraped with a toning knife and blended into wax color with iron oxide toner or oil painting pigment.

2. Iron oxide toner
Iron oxide is an inorganic substance with chemical formula Fe₂O₃. Red or crimson amorphous powder. Relative density 5–5.25, melting point 1565°C (simultaneous decomposition). Insoluble in water, soluble in hydrochloric acid and sulfuric acid, slightly soluble in nitric acid. It has strong hiding power and coloring power, and has no oil permeability and water permeability. Stable in the atmosphere.
and sunlight, resistant to dirty gas, high temperature and alkali. The dry product of this product has coarse and hard crystal particles, and is suitable for magnetic materials and polishing and grinding materials. Wet-process products are fine and soft, which is suitable for coating and ink industry [1].

It can be seen from Baidu's entry that iron oxide, as an inorganic pigment, is widely used in coating and printing industry. It has high light resistance, and the colors of coatings and inks prepared with it are unchanged for a long time. However, from the perspective of artistic pigments, it is far from being explored by people, and its application methods, characteristics and effects need to be studied and explored. I used it as pigment toner in the exploration of hot encaustic, and used it in the creation of hot encaustic in combination with wax. Because there was no experience of using metal materials in hot encaustic before, and no relevant information was found, many operation modes were tried. By comparing the picture effects produced by different operation modes, I accumulated relevant experience, hoping to enrich the materials and techniques of hot encaustic art.

Table 2. The experimental table of the ratio of wax material to iron oxide toner is as follows:

| Blended wax material | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
|----------------------|----|----|----|----|----|----|----|
| Iron oxide toner     | 0.5| 1  | 2  | 4  | 6  | 8  | 10 |
| Cohesive force       | Strong | Strong | Strong | Stronger | General | Weaker | Weaker |
| Toughness            | Strong | Strong | Strong | Stronger | General | Weaker | Weaker |
| Chroma sense         | Weaker | General | Stronger | Stronger | Strong | Strong | Strong |

Through experiments, it is found that the added amount of iron oxide toner is directly proportional to the color layer feeling of wax color, but inversely proportional to its adhesive force and toughness. It is more appropriate to add the amount between 0.5 and 6 parts according to different effects of the picture. Too much toner can easily lead to foaming when wax color is heated, and the color adhesion is not strong, which is not conducive to long-term preservation of pictures.

3. Oil paints

Oil painting pigment is prepared by mixing toner with linseed oil or poppy oil, which has the same composition as linseed oil in wax. Beeswax is often used as repair material in painting conservation to improve the adhesion and stability of pictures. Based on the above factors, the oil painting pigment and wax were blended and used as supplementary materials when the color of iron oxide toner was few.

Table 3. The experimental table of wax and oil painting pigment ratio is as follows:

| Blended wax material | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
|----------------------|----|----|----|----|----|----|----|
| Oil paints           | 1  | 2  | 4  | 6  | 8  | 10 | 12 |
| Cohesive force       | Strong | Strong | Stronger | Stronger | General | General | Weaker |
| Toughness            | Strong | Strong | Stronger | Stronger | Stronger | General | Weaker |
| Chroma sense         | Weak | General | Stronger | Stronger | Strong | Strong | Strong |

Through experiments, it is found that the amount of oil painting pigment is directly proportional to the sense of wax color layer, but inversely proportional to its adhesion and toughness. When the oil painting pigment is more than 8 parts in weight, it is easy to foam when heated, which is not conducive to the color fixation on the picture, so it is more appropriate to add 1 to 6 parts in weight.
3.2. Painting steps

1. Substrate preparation
   The supporting materials of the picture can be wooden boards, metal plates, canvas or the canvas can be glued on the board. When painting with wooden boards, the back can be coated with wax liquid to isolate the wooden boards from the air.

2. Draft
   The materials are not limited, and you can use charcoal strips, pencils, and Chinese ink to compose the manuscript.

3. Apply wax color for the first time
   Scratch the prepared wax color evenly on the screen. Refer to the experimental table above for specific ratio. The color can be simpler, and gradually enrich the color in the next few times. Pay attention to that the first wax color should be slightly thinner, because if it is too thick, the covering effect of the next second wax color will be difficult to grasp. After scraping the wax color, it is heated with a flamethrower. During the heating process, the wax color will diffuse around due to the impact of the flamethrower fire, thus forming a certain missing effect. Moreover, different heating degrees will also make the color form a colorful visual sense.

4. Apply wax color for the second time
   Specifically, there are two situations: First, fill a layer of wax color in the place where the color loss is serious in the first pass; Second, according to the creative intention, scrape a layer of wax color on the basis of the first wax color. When heating, the visual effect of mutual fusion or overlapping between the upper and lower wax layers can be achieved by controlling the flame angle and the fire size of the flamethrower. Although it is difficult to predict the final appearance, the uncertain factors of the picture can be controlled after trying, which can be used as a technical means to enhance the visual richness, which is also the characteristic and charm of hot encaustic. In the process of waxing and heating, attention should be paid to the picture modeling, color and local details. This in-depth shaping method can be repeated until the picture is complete.

Figure 1. Effect after the first wax heating
Figure 2. Effect of second wax heating

5. Improve the picture through the use of metal materials

Including the use of solid metal materials such as iron powder, lead powder, lead scrap, lead bar and liquid metal, the different presentation forms of metal and wax color are used to further enrich the details and adjust the picture relationship, so as to achieve the purpose of deepening and enriching the visual effect and completing the picture. On the one hand, beeswax is equivalent to latex, which plays the role of bonding metal materials and fixing them on the screen; From the material point of view, beeswax and metal are juxtaposed on the screen, and the softness and tolerance formed by wax color between different color layers form a strong contrast of texture and texture with the hardness and weight of metal. The modeling edges presented by the two materials are also quite different, the wax color is faint and subtle after melting, and the metal edge is clear and sharp. These contrasts enrich the visual factors of the picture, and artists can convey their own emotional experience and spiritual orientation by dealing with the relationship between the control of picture color tone, the creation of atmosphere, and the overall and local contrast. Here, materials are not only the expression medium, but also the modeling language.

It should be noted that iron oxide toner is finely ground and can be blended with wax material for use, while solid metal chips, such as lead chips, are too large to be blended with wax material. Its application mode is to scrape a relatively thick layer of wax color first, and then spread the lead chips on it for heating. After being heated and melted, the wax color can wrap the lead chips and form a good fixing effect after cooling. If the wax color thickness is thin, the missing effect will be formed under the fire impact after being heated and melted, which can not wrap the lead scrap, and it is difficult to fix it on the picture.

In the application of iron powder and lead powder, because the powder is very fine, there are two ways: first, it is directly blended with wax like iron oxide toner and then scraped on the screen for heating; second, it is sprinkled on the wax color scraped on the screen like metal chips for heating. In the heating process, when the fire increases, the metal powder and wax liquid will have a separation effect, and the colors between the upper and lower wax layers will blend, forming a colorful effect similar to the glaze kiln change of Chinese ceramics. If properly controlled, it will have a better visual experience. As far as picture exploration is concerned, I like the feeling of a certain dissociative state, and the content reflected in the picture presents a weakened concrete image, which is vague but vaguely shows a specific attitude. This colorful effect better meets my requirements for picture language.

Lead is a kind of metal material with good ductility. Because of its soft properties, it can be tempered and cut into required shapes, such as lead skin, lead block, lead wire, etc., which can be used to form a
three-dimensional effect similar to relief. The melting point of lead is low, so artists can easily melt it to get lead solution, which is used to show irregular appearance on the screen and easily produce some unexpected accidental effect. The uncertainty in the process of creation also provides more possibilities for the works, and artists can use their imagination to create further, which is similar to the effect of "splashing ink" in traditional freehand Chinese painting.

![Figure 3. Picture completion effect:](image)

In the whole painting process, it is particularly important to control and apply the heating degree of wax color. Factors such as the fire intensity, running direction and mode (vertical, sideways, fast, slow, etc.) of the flamethrower will make the wax color show different visual effects on the picture. Therefore, the exploration of heating mode is determined by the individual's requirements for the picture language. It should be noted that the heating degree cannot be increased indefinitely, and overheating will adversely affect the adhesion between wax color and the support body. In addition, the flexible use of different proportions of wax and toner can also be used as a means of picture expression. When the content of wax toner is low, heating will show a translucent effect between the upper and lower wax layers; When the wax toner content is relatively high, the color of the upper and lower wax layers can be superimposed or fused by controlling the heating degree. These different effects play a supporting role in enriching the visual language of the picture.

4. Conclusions
Based on the idea that technical materials and painting art complement each other, while studying the techniques of hot Encustic materials, through experiments and attempts, the combination of metal materials (iron oxide toner, ferroferric oxide powder, iron powder, lead powder, lead strip, lead scrap, lead solution, etc.) and hot Encustic techniques meets my requirements for picture effects. Because beeswax has reversibility of heating and melting, it is easy to modify at any time, and its non-hydrophilicity after drying can isolate the invasion of moist air to the internal color layer of the picture, which is conducive to long-term preservation, and it is a feasible comprehensive material technique. Of course, many technical details have yet to be further verified and determined in practice, such as the influence of the proportion of various materials in wax blending on the firmness, toughness, drying time and hardening degree of the picture; Color durability of wax color prepared from iron oxide toner and wax material; The use of different metal materials, etc. Therefore, the research on a kind of material technique needs a long time of experiment and observation to draw a more objective conclusion.
As far as techniques are concerned, this paper only makes some research and experiments on the application of metal materials in hot encaustic, and other materials can also be used in hot encaustic. Material technique is the way and tool for artists to convey their own spiritual experience and artistic ideas, and its relationship with artists' creativity should complement each other rather than be restricted by it. Any technique is not absolutely perfect for artists, and only through continuous innovation and practice can we explore painting techniques and language suitable for individuals.

References
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