

## PROCEEDINGS ARTICLE

# Research on the History of Chinese Copper Coloring Techniques

Lisheng Zhang<sup>1,\*</sup><sup>1</sup> Xiamen Academy of Arts and Design, Fuzhou University, Xiamen, China

## ABSTRACT

By studying the factors and historical context of copper coloring techniques, the author of this paper can conclude that China began to use special methods to treat copper surfaces in ancient times; the development of coloring art is influenced by politics, economy and culture. Whatever the purpose is, it invisibly drives the copper coloring techniques to the essence of art.

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## 1. INTRODUCTION

The copper coloring techniques are the product of continuous attempts in the development of human art. Coloring methods are divided into natural coloring, transformation coloring and artificial oxidation coloring. Natural coloring is the so-called "patina" or "verdigris" of copper rusting, which is related to the chemical changes on the metal surface; the transformation coloring is to add or reduce some elements from the copper to make an alloy, and the content of other elements will cause the color change of the alloy, and then change the color; artificial oxidative coloring is a special technique that treats the coloring layer between the casting substrate and the external environment, forms an interference film on the metal surface, absorbs light of a certain wavelength, and makes the surface appear colored after reflection. The copper surfaces are decorated with color to further enhance their aesthetic form. So when did this kind of aesthetics that can show the changes that natural colors have? Regarding the development history of Chinese copper coloring technology, the author has sorted out the relevant literature as follows.

## 2. THE "BRONZE AGE" OF CHINA'S COPPER COLORING HISTORY

The "bronze blade" of the late Neolithic period was discovered at the Majiayao cultural site, which is the earliest bronze ware discovered in China so far. After scientific testing, it contains a certain amount of tin. Adding a certain amount of tin to brass in the refining process can not only reduce the melting point, but also enhance the hardness, causing the color of the brass surface to change to cyan, which belongs to the transformation coloring method in copper coloring techniques. This historical stage was also called the formation period of the Bronze Age by archaeologists, and at the same time opened the prelude to the artificial coloring of copper materials in China.

More than 1,600 years from the Xia Dynasty to the early Warring States period was the heyday of the copper Age in China. Because the Xia Dynasty is too long, there is no direct literature to show that the copper coloring process appeared in the Xia Dynasty. During the Shang Dynasty, the status of the bronze ritual ware was improved, and the shape changed. The phenomenon of pottery imitation bronze ware appeared from the bronze transformation of the early

\*Corresponding author. Email: [201727003@fzu.edu.cn](mailto:201727003@fzu.edu.cn)

pottery shape, which showed the particularity of the bronze ware in the Shang Dynasty. "During the Shang and Zhou Dynasties, this kind of brightly colored and lustrous lacquer was also used to decorate bronze ware" [1]. The bronze tripod of the late Shang Dynasty unearthed in Mangzhang, Luoshan, Henan, was filled with black lacquer on the base, and the base was covered with black lacquer. It belongs to the coloring of the physical level of copper coloring technology. By applying a certain amount of lacquer, it can not only carry out surface decoration, but also prevent the copper tripod from being oxidized by contacting air.

The phenomenon of bronze ware imitation appeared in the Western Zhou Dynasty. The bronzes unearthed in the Western Zhou cemetery in Shigu Mountain have certain differences in decoration and craftsmanship. After in-depth research, there is evidence that the unearthed bronzes are imitations. "It may be a common phenomenon that bronze wares from the early Western Zhou Dynasty imitated bronze wares from the late Shang Dynasty. Similar imitations also exist in Zeng State Cemetery in Yejiashan Mountain in Suizhou and Yan State Cemetery in Beijing Liulihe, which also confirms this" [2]. Imitation will appear the process of "old copper tire", which involves the artificial oxidation and coloring of copper surface.

In the Spring and Autumn Period, there are also documents describing the imitation of ancient bronzes, "The State of Qi attacked the State of Lu. The State Qi asked for a tripod, and the State of Lu sent the counterfeit product" [3]. For many years, it has been believed that the imitation of ancient bronzes began in the Spring and Autumn Period. From the description of this document, it is obviously earlier than this period. From the late Spring and Autumn Period to the early Warring States Period, the gold sticking process appeared. This process is to use gold foil to stick on the copper. "The later generations are cooked tung leaves boiled with gold glue oil and a small amount of flax leaves, pigments or blending paint or lacquer paste. Based on this, some scholars speculate that lacquer or tung oil may have been used as paint in ancient times as a sticky substance" [1]. Gold sticking can be said to be another decorative form of copper coloring. After the early Warring States period, bronze gilding techniques appeared. For example, some gilded bronzes unearthed from the mid-Warring States tombs in the ancient city of Lu in Qufu and the mid-Warring States tombs at Zhongzhou Road in Luoyang were mainly made by melting gold into mercury to make gold amalgam, and then dipping a copper rod with nitric acid and evenly spreading it on the surface of the utensils, and heating the mercury to evaporate. And then the gold will stay on the

surface, and a gilt layer will be formed through a series of processes. Some bronze utensils unearthed in the mid-Warring States period tomb of Zhongzhou Road in Luoyang were partly made of gilt silver, and the main method was the same as that of gilt. During the Warring States Period, the copper chrome plating process also appeared. Because chrome is a silver-white metal, similar to tin, plating on copper surfaces produces a bright and beautiful appearance and resists corrosion. For example, in Luodong, Guangdong Province, chrome-plated bronzes were found in the Warring States Period, and tin and chromium were used to protect bronzes.

From the end of the Warring States period to the end of the Qin and Han dynasties, the social system formed by the patriarchal system, the economic foundation formed by the well-field system, and the changes in people's traditional thinking due to the changes in people's traditional thinking, completely disintegrated the traditional etiquette system, and the status of bronzes also declined. Coupled with the advantages of low cost and a wide range of materials, the development momentum of ironware has become stronger and stronger. Due to the limitation of the material itself, the development of bronze ware has hindered its development, so the bronze manufacturing industry has gradually declined and entered the late "Bronze Age". The Qin Dynasty broke through the shackles of bronze casting patterns and the Spring and Autumn Period and the Warring States Period, such as gold-plated silver, and gold paste. The creation of a unique full-body painted bronze vessel — "Qin painted bronze chariots and horses", added the decoration of the bronze chariots and horses and covered up the defects during casting. Although the painted patterns have been oxidized and fallen off for a long time, through modern technology, through modern technology, copper chariots and horses can also be observed, indicating that there are still residual traces of color. There are more than ten kinds of colors: vermilion, emerald green, white, dark blue, yellow, etc. "Some of the colors are the processed products of natural ores, and some are artificially synthesized minerals, which are bone white made from animal bones fired at high temperature. Green and blue are extracted from natural ores, blue is azurite, green is malachite, and the two colors are accompanied by two colors; red is cinnabar color, the main component is mercury sulfide, which is the most widely used pigment in ancient China" [4]. Compared with previous periods, copper coloring uses a variety of colors for surface decoration and coloring has developed significantly.

The Han Dynasty highly regarded lacquerware, which accelerated the decline of bronze ware in the Eastern Han Dynasty to a certain extent, and made people's aesthetics deviate. Bronze ware is declining day by day, but the decorative craftsmanship was still progressing. The development of interlaced gold and silver craftsmanship reached its peak in the Han Dynasty. For example, the well-known Han Dynasty bronze horse stepping on a flying swallow is a wrong silver craft, and the eyes of the horse are painted with gold. In the Western Han Dynasty, there were also full-body painted paintings like the Qin Dynasty. For example, the painted bronze lanterns of the Western Han Dynasty were unearthed in Shuozhou City, Shanxi Province. The main colors were emerald green and red. In the Han Dynasty, the production of bronze mirrors reached a peak. The main component was high-tin and lead-containing bronze. Due to the high tin content, the overall bias was white, and it was easy to obtain a clear image.

### **3. COLORING HISTORICAL PERIOD WHEN RELIGIONS PREVAILED**

The rise of metaphysics in the Wei and Jin Dynasties led to the rapid development of Buddhism. In order to worship Buddha and honor Sakyamuni, people believed that statues were the merits of the present world, and both the government and the people spared no expense. During this period, the wind of casting bronze Buddha statues involved the whole country, and large bronze Buddha statues appeared. It is described in the earliest book on the history of Buddhism, "Book of Wei · Shi Lao Zhi": "In AD 454, the relevant departments were ordered to cast five statues of Sakyamuni for the five emperors below the Taizu in the great temple, about 4 meters high and 250,000 catties of copper. In 467 AD, a statue of Sakyamuni was erected in Tiangong Temple, about 14 meters high, with 100,000 catties of copper and 600 catties of gold" [5]. To maintain the brightness, large bronze Buddha statues would be colored with golden dry lacquer, and the same method would be used in the corresponding Buddhist bronze utensils. In the Northern Dynasties, in addition to the great development of bronze mirrors, other bronze wares gradually declined due to the increase of gold and silver utensils and porcelain. "The imitation and counterfeiting styles of bronze wares formed in the Tang Dynasty are: the imitation ware is finer in texture than the real ware, and the hard outer shell is more silver-gray, giving a feeling of being cooked; different from bronze wares of the third generation, the rim, neck and ring feet of the imitation ware have

swirl patterns inside and outside, the bottom of the ware is more sinking, and the feet are higher" [6]. Most of the imitation bronzes in the Tang Dynasty were silver-gray because the bronzes contained high levels of tin and lead. The development of gold and silverware in the Tang Dynasty was relatively rapid, similar to the situation in the Wei, Jin, Southern and Northern Dynasties. Except for large-scale bronze Buddha statues, bronze statues of gods and commonly used bronze mirrors in temples, bronzeware was basically marginalized during this period.

### **4. RECONSTRUCTING THE "CLASSIC OF THREE GENERATIONS"**

"A large part of the bronzes produced in early China were destroyed in the 10th-13th centuries AD, and this factor led to extensive attempts to imitate ancient bronzes" [7]. The 10th-13th century AD corresponds to the Northern Song Dynasty-Jin Kingdom of China. During the Song and Jin Dynasties, there were strict bans on copper to curb the development of copper art. During the period, there were occasional relaxations. This also explains the historical reasons for the development of bronze wares at that time. When the bronze ware policy in the Yuan Dynasty was liberated, the copper craftsmanship at this time also developed into an unprecedented event. The corresponding dynasty in China in the 12th century was the end of the Northern Song Dynasty. The emperor Song Huizong vigorously advocated that he established the Ritual Bureau to be responsible for the production of antiques, and strived to restore the "Classics of Three Dynasties". Coupled with the development of epigraphy, it provides a research direction to regenerate the long-silent bronze art of the Song Dynasty in the form of antiques. People tried to imitate the bronze wares unearthed in the Shang and Zhou dynasties for surface coloring. Regarding the color of the coloring, the author also found relevant descriptive documents. "Ancient copper insists on ancient green, mostly showing the color of tea leaves, mostly thunder patterns and patterns" [8]. "The craftsmen need to first use mercury mixed with tin and mercury on new copper ware, then use a pen to dip a mixture of vinegar and fine sand, spread it evenly on the surface, wait for a period of time to turn into tea green, quickly soak in water, and finally form a tea green. If it becomes pitch black after a period of time, they will soak it in water quickly, and eventually it will become pitch black. When immersed in water slowly, its color will change" [9]. At that time, the antique coloring already had green, black and other colors. According to the literature review, the Song

Dynasty used lacquer and turquoise foam to burn and cast it, and it was also soaked in hydrochloric acid water to rust, but the color was mostly light green and relatively monotonous. There is also a method of soaking lacquer surface with alcohol, which has more color layers but is looser and easy to fall off. After the Song Dynasty, because tin was relatively rare, the content of lead was increased when making bronze and a certain amount of zinc was added.

During the Yuan Dynasty, the government set up a wax bureau to imitate bronze, and commercialized antique bronzes appeared in the folk, with more colors and types, and the shape also tended to be exaggerated, reflecting the distinctive characteristics of the times. "Shen is good at casting bronze tripods, bronze ritual vessels, etc. The color is old grass color, which can be used to match the fake with the real" [10]. "The craftsman who is called 'Jiang Zhu', his furnaces cast is yellow copper furnaces with taotie patterns, and plain copper tripods without patterns" [11]. They innovated the copper coloring method of old grass color and solid color. The Yuan Dynasty inherited the style of the Song Dynasty in terms of antique ritual vessels. Since the rulers respected Taoism and Confucianism, the development of bronze vessels cannot be separated from the use of ritual vessels. Antique incense burners, bottles and other items are the most common in the Yuan Dynasty ruins, such as, the Yuan Dynasty antique sacrificial vessel with dragon pattern, three-legged cable-ear li stove was unearthed in Yanqing County, Beijing, antique bronze vase with square mouth was unearthed at the Yuan Dynasty site at Jingzhou Road in Ulanqab, Inner Mongolia, etc.

During the Ming Dynasty, with the support of those in power, copper coloring techniques developed rapidly. The famous Xuande furnace is the first high-quality copper furnace made of "wind-milled copper" (brass alloy) in Chinese history, setting off the second wave of revival of ancient ritual vessels in history. There are a variety of colors melted in its color. In the "Xuande Yi Ware Map" written by Lu Zhen in the Ming Dynasty, there are 23 colors of Xuanlu: "the turquoise that imitated the ancient, wax brown (yellow with black), purple-brown, tangli tree color (yellow with red), jujube red, Tibetan scripture paper color (light yellow), etc." [12]. The coloring method of Xuande furnace adopts the process of drug spot dyeing. The surface colors of different plants and minerals are ground into powder. When casting in a copper furnace, coloring and sintering are carried out several times, then the color material is impregnated into the furnace surface, and finally, melted white wax is used to cover and protect the furnace body. This method is

somewhat like the coloring of bronze chariots and horses in the Qin Dynasty mentioned above, and the decoration method also uses "sprinkling gold" and other methods. In the Ming Dynasty, the types of coloring were more abundant, no longer simply imitation, but created a variety of new copper coloring arts in the form of imitation and retro innovation.

The Qing Dynasty reached its heyday in the imitation of ancient bronzes. The Office of the Ministry of Internal Affairs was set up to imitate bronzes. It vigorously advocated the study of classics and the reconstruction of the ancient ritual system of the three generations, and compiled classics such as "Complete Works of Chinese Classics", "Xi Qing Gu Jian", "Xi Qing Xu Jian" and "Schemas of Ritual Vessels of the Dynasty", etc. "The imitation bronze ware is mostly yellowish, and the quality is heavy; it is often waxed with a black background, and it pretends to be a well-cooked utensil to confuse people" [6]. Since the Ming Dynasty, the content of tin in copper alloys has decreased, and the surface color of the castings produced is mostly yellowing.

## 5. DEVELOPMENT OF MODERN COUNTERFEIT WARES

Modern China was in a state of war, and the country was in turmoil. The development of bronze is no longer "antique" but "counterfeit". The main difference between the two lies in the purpose of making utensils. "Antique" refers to imitating the systems, etiquette and substantive utensils of ancient ancestors. In the process of imitation, it will go through the stages of archaeology, antique, and ancient, and "counterfeiting" is to fake through technical means driven by the pursuit of interests. Bronze coloring in modern China began to appear in the east, west, north, south, and central regions. "East" refers to Weixian and Jinan, referred to as "Weixian school". At the end of the Qing Dynasty, because Western capitalism stimulated the development of the Chinese antique market, the "Weixian faction" also took advantage of the situation to develop into its heyday. It is recorded in the "Weixian Chronicle": "Antique bronze ware first started from the surname Li in Dongguan, Weixian County, and the imitation bronze ware can be as good as the real one" [13]. "Small pieces are cast as a whole, similar to the real utensils; to make it old and burry in the ground, and chemical components such as hydrochloric acid are added to form green rust and red rust, and then make it like the ancient ones" [14]. Occasionally, a mixture of copper powder and iron powder is added to the



surface of the copper ware to obtain different kinds of patina on the surface. The most famous bronze fake rust of "Weixian School" is mostly emerald green and light green lacquer. It is obvious that the coloring method of "Weixian school" in modern times has been close to modern technology. "West" is dominated by Xi'an, referred to as "Xi'an school". The Xi'an school is good at imitating artificial oxidation under natural conditions. It can be traced back to the Tang Dynasty. "South" refers to Suzhou, Hangzhou and other places, referred to as "Suzhou school". The "Suzhou school" has a long history of making counterfeit ware. "Suzhou Chronicle" records: "There are no less than thousands of bronze wares produced in Xicheng, and they are meticulously crafted" [15]. In terms of coloring technology, it is divided into two categories: leather color and fake rust, and leather color is also divided into two types: one refers to lacquer and mineral color to make and smear the surface of copper ware, and the other is to soak the copper utensils in a solution containing charcoal and water for a long time, and then configure the solution such as sand and vinegar to treat the surface of the copper utensils to produce a certain surface color. To fake rust is to oxidize copper rust with various chemicals such as hydrochloric acid, acetic acid, and sand, and "stuffy rust" in the ground to fix the surface rust. In addition, the "Suzhou school" will add silver material when smelting copper, and the resulting leather will be white. The "north" here refers to Beijing, referred to as the "Beijing school", which was one of the important factions in counterfeiting during the Republic of China. The heritage is relatively long, and most of them are imitations of Shang and Zhou bronzes, forged gold and silver wares of the Tang Dynasty, and in the restoration of cultural relics, the representative figure is the "bronze Zhang". In terms of restoration, the process is to weld the broken parts of the bronze first, and use waterproof foreign paint to make them old. There is also a description of the traditional rust-spotting method of colored patent leather: "soak the shellac lacquer sheet with alcohol to dissolve it into a binder, and then add various colors of pigments for use as needed" [16]. Lacquer polishing method is based on the rust-spotting method of the patent leather, and after the paint is air-dried, rub it with a coarse cloth to shine, and in modern times, sandpaper is used instead. Spotting and rust spraying method is to "mix soil and water into yellow mud, and use tools to spread it on the surface of bronze ware. After the yellow mud is air-dried, use a toothbrush to dip in the mixed shellac water and color it in a special way. After the shellac is dry, use a hard steel brush dipped in water to brush off the yellow mud, leaving the surface where the paint flakes and pigments are

attached to form an artificial rust layer" [17]. In the long-term practice, the "Beijing school" coloring is also more simulated. Finally, "central" refers to Kaifeng, which is located in the ancient capital of the Song Dynasty due to its geographical location. Bronze imitation and production are uniquely endowed with a large number of skilled craftsmen, and their skills are also unique in a school.

Modern coloring has developed more rapidly on the basis of tradition, and there are dip coloring, steam coloring, smoke coloring, cold coloring, hot coloring, oxidative heating coloring (torch coloring), etc., which further shorten the production time. There are also composite processing technologies combined with other processes; the methods will not be described one by one. In general, the development history of bronze coloring in China has created different coloring techniques and colors, and promoted the development of modern coloring technology.

## 6. CONCLUSION

The copper coloring technique is a product of the development of material art and evolved into a decorative layer. It is an aesthetic choice, which undoubtedly increases the decorative effect of copper as a precious object. Throughout the history of copper coloring, special treatments were used to change its surface color in ancient times. The development of Chinese copper coloring art is inseparable from the foundation of politics, economy and culture. Bronze ritual vessels in the Xia, Shang and Zhou dynasties are a side manifestation of the social system. The casting of ritual vessels is essentially the construction of ritual systems, showing the special status of users; After the Zhou Dynasty, due to the limitation of copper material itself, it was marginalized and the social system of "destruction of rituals and music" led to the replacement of iron ware, porcelain, gold and silver ware, and the art of copper coloring has increased unabated due to the rapid development of the craftsmanship of other materials; Subsequently, Song, Ming and Qing Dynasty proposed that the essence of "reconstructing the code of three generations" was to rebuild the repression of human rights by the king's way, so the art of bronze coloring was developed again; In modern times, due to various factors such as war and chaos, it has changed from "imitate antique" to "fake" in pursuit of interests. Whether it is coloring for imitation of ancient copper ware or color decoration for aesthetic considerations, it has new meanings to the original artworks, and also promotes the development of copper coloring art invisibly.

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