

# *Chinese Porcelain Culture in Ceramic Courses of Universities*

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**Abstract:** Ceramic is the earliest material manufactured by human using the natural material, and has been considered the most promising candidate material for the high-temperature structural components in the 21st century and "the dream of the ultimate material". Ceramic courses in universities are the important project component of materials discipline, which could guide students towards a life of intelligence and beauty. This article introduces the development process of Chinese porcelain and the relationship between porcelain composition and color. It helps us to explore the combination of education and humanities, to experience the unique charm of Chinese porcelain culture.

## **1. Introduction**

Porcelain, with its fascinating patterns and excellent craftsmanship, is widely loved by people from all over the world. Porcelain patterns cover the natural scenery, character stories, animal and flower, traditional culture, and so on, which show various forms and exquisite beauty<sup>[1-4]</sup>. Porcelain works like three-dimensional paintings, showcasing people's longing and pursuit for a better life to the world.

As the traditional handicraft, porcelain is a treasure of the ancient Chinese culture that carries rich historical connotations and cultural inheritance<sup>[5]</sup>. In ancient China, porcelain was used as the tool not only for the nobility and court, but also in the daily life of the ordinary households. Whether the exquisite artistic skills or the harmonious forms and proportions, they all reflect the pursuit of harmony, balance, and the golden mean in ancient Chinese culture. Porcelain product is an art form that integrates ancient ethics, customs, life, technology, and economy. With the opening of the Silk Road, porcelain gradually spread to Western countries and became a bridge for cultural exchange between China and foreign countries that played an important role in communication, exchange, and cultural inheritance.

The content of ceramic courses in universities is the inheritance and extension of traditional ceramic knowledge. Through knowing ceramic culture, students could deeply understand the theoretical knowledge in the course, enhance their interest in learning, broaden their horizons, and improve their ability to solve complex problems about ceramics.

## 2. The development of porcelain

Ceramic is the general term for pottery and porcelain. Pottery and porcelain have similarities as well as many differences. Firstly, the raw materials are different. Pottery is made using pottery clay. While porcelain requires porcelain clay, also known as Kaolin, which is named after its earliest discovery in Kaolin Village, Jingdezhen Township, Jiangxi Province. Kaolin is formed by the weathering, metamorphism, hydration, and deposition of mica and feldspar. During its transformation, Kaolin elements such as sodium, potassium, calcium, and iron are almost lost. The chemical formula of pure Kaolin is  $2\text{SiO}_2 \cdot \text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ , whose color is white or gray white. Pottery clay is mainly composed of kaolinite, hydrous muscovite, montmorillonite, quartz and feldspar. In addition to silica and alumina, pottery clay also contains a certain amount of ferric oxide, calcium oxide and magnesium oxide. The presence of iron trioxide makes the clay have colors such as yellow brown and red purple. And for this reason, the most common color we see in pottery is the yellow brown series.

China invented "primitive porcelain" - celadon ware more than 3500 years ago in the Shang Dynasty (1675-1029 BC) [6]. From the Shang Dynasty, the Western Zhou Dynasty (1029-771 BC), through the Spring and Autumn Period (770-476 BC) and the Warring States Period (475-221 BC) to the Eastern Han Dynasty (25-220), Chinese porcelain developed from immaturity to maturity. The Northern and Southern dynasties (420-581) entered the complete porcelain stage. The Tang Dynasty (618-907) was the golden period for the development of porcelain. At that time, Blue and white porcelain was an important breakthrough in the history of Chinese porcelain [7]. Through the use of blue minerals and firing technology, the beautiful blue and white porcelain was created. The Yuan Dynasty (1271-1368) was another peak period for the development of porcelain. The overglaze colored porcelain became the representative work. By adding metal oxide pigments on the surface of porcelain and combining glaze techniques, a variety of overglaze decoration color porcelain was created. The Ming Dynasty (1368-1644) was another one of the golden periods for the development of Chinese porcelain. During this period, the production of blue and white pottery reached its peak. The porcelain covered various natural elements such as flowers and birds, mountains and rivers, which was full of auspicious meanings and cultural connotations. The Qing Dynasty (1644-1911) was a turning point in the development of porcelain. The painting porcelain laid an important foundation for the development of porcelain art. The European porcelain born during this period. The Qing Dynasty was the prosperous period for the three-dimensional painted porcelain and export porcelain. Chinese porcelain art had developed towards the more complex direction.

## 3. Composition and color of porcelain

The content of calcium/magnesium oxide in primitive porcelain (celadon ware) of the Shang Dynasty was lower than 1%, and the content of iron oxide was lower than 3%. While the content of calcium/magnesium oxide and iron oxide in pottery was higher than 3% and 6% respectively [8]. The colorant for celadon ware is iron ion. When in an oxidizing atmosphere, it mainly generates iron trioxide, which turns the glaze yellow. When in a reducing atmosphere, it is divalent iron and the glaze color tends to cyan green (Figure 1).

With the continuous maturity of ancient Chinese bronze smelting technology, craftsmen discovered that adding lead to copper tin alloys would lower the melting point of bronze and enhance the alloys fluidity. Thus low-temperature lead glazes were made. Subsequently, the green porcelain with copper as the colorant and brown porcelain with iron as the colorant emerged. The glaze changed from single color to multi color. Sancai is the representative of multi-color glaze, which is mainly composed of yellow, green and brown. The green comes from Malachite and Azurite, whose main component is basic copper carbonate. And the yellow and brown come from ferric oxide.

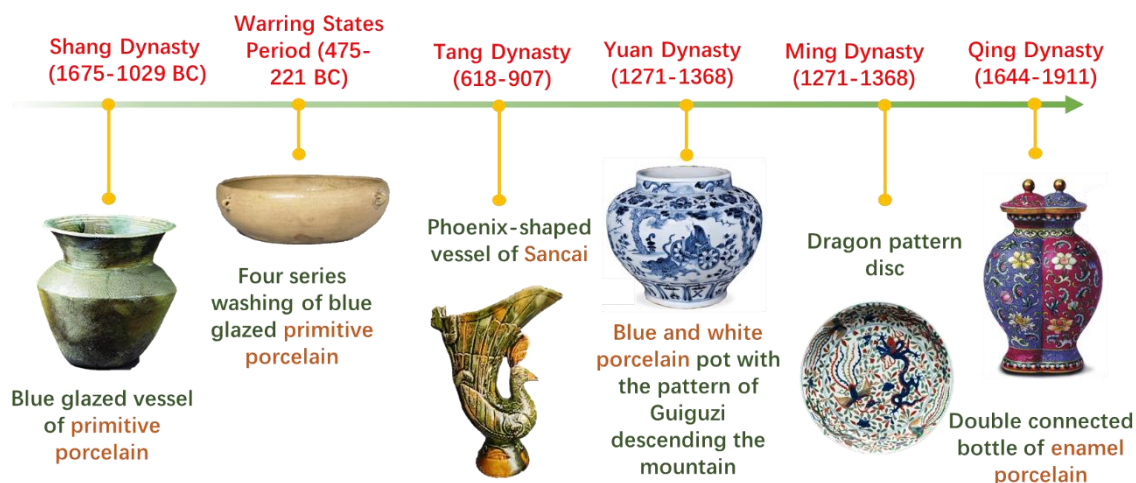


Figure 1: Changes in color of Chinese porcelain

The glaze of porcelain in the Song Dynasty contained various elements such as copper, tin, titanium, and phosphorus, which were the internal conditions for the multicolor kiln transformation. For example, about 0.5% of copper oxide is reduced to colloidal copper ions at above 1200 °C. These ions will form a red glaze, or a mixture of cyan, red and other colors. The technology broke the single color of the green glaze and formed different glaze colors such as sky blue, moon white, rose purple, crabapple red, gray blue, dark green and eggplant skin purple, and so on.

Since the Tang Dynasty, the blue and white porcelain mainly contains cobalt compounds and other metal oxides, which flourished in the Yuan and Ming Dynasties. Glazes containing 0.25% cobalt oxide exhibit the brilliant blue color. While 1% cobalt oxide gives the glaze a very deep blue color. Glazes with cobalt oxide higher than 1% exhibit the blue-black or black color. The content of manganese and iron also affects the color of glaze. Manganese appears reddish purple in sodium glaze, blue purple in potassium glaze, and iron appears tea black.

The Ming and Qing dynasties were the heyday of Chinese colored porcelain that was developed on the basis of low-temperature glaze. The basic colors of colored porcelain include red, yellow, green, blue, purple, and other colors. There are both monochromatic glazed porcelain with rich color and multicolored porcelain with complementary colors, which are painted on the glaze according to the needs of the pattern and then baked again <sup>[9]</sup>. The red color comes from iron oxide. The main component of iron yellow is iron sulfate. The main component of antimony yellow is antimony oxide. Green color originated from copper green lead glaze, whose colorant is divalent copper ions. Blue comes from cobalt oxide. And purple comes from manganese colorants.

#### 4. The influence of Chinese porcelain on the world

Porcelain is one of the symbols of Chinese culture. As an important bulk export commodity in the international trade, porcelain has long been spread to many regions of the world.

Archaeological evidence showed that as early as around the first century, ceramic vessels from the Qin and Han dynasties in China had spread to the present Malay Peninsula. By the Tang Dynasty, they were sold to many regions in West Asia and East Asia. Not only the development of ceramic technology in the Korean Peninsula, Japan, Mainland Southeast Asia and other regions around China was obviously affected by Chinese ceramic technology, but also in Western Asia and later Europe, they learned a lot from China's exquisite skills of porcelain making. Under the historical background of the prosperous Tang Dynasty, Sancai had become the imitation and learning object in many parts of the world, and had bloomed regional "sister flowers" with different characteristics in different

regions, such as Hetian porcelain in Japan, Montblanc porcelain in Britain, Limoges porcelain in France, etc.

Porcelains showcase the diligence and wisdom of the Chinese nation to the world, and the diligence and wisdom of the people around the world also create the colorful connotations and characteristics of porcelains.

## 5. Conclusions

The development and innovation process of porcelain technology is often very interesting and enlightening. Enlightenment and innovation are important components for the higher education. Chinese people have created splendid porcelain by controlling the composition through continuous efforts, which adds color to their world and gets a glamorous life. As one of the symbols of Chinese culture, porcelain has spread to many regions of the world by way of an important bulk export commodity in international trade.

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