

Analysis of the Chemical Composition, Properties, Aesthetics, and Craft of Zisha Clay: A potential environmentally friendly material for jewelry design

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Abstract

Zisha clay has always been regarded as the preferred material for making teapots, but its potential as a human body decoration has rarely been explored in depth. This article aims to study and analyze the material composition, property, aesthetic, and craft innovation of Zisha clay in jewelry design. Exploring Zisha clay as a new jewelry material broadens its application and provides a new perspective for its sustainable development in the jewelry industry. Zisha clay is more accessible and environmentally friendly than traditional jewelry materials, so this study is of reference value for promoting the creative industry.

Keywords: Zisha clay; jewellery; properties; craft

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1.0 Introduction

This study aims to explore and analyze the potential of Zisha clay as a sustainable and environmentally friendly alternative to traditional jewelry materials. Zisha with its unique tone and material characteristics in the field of ceramics, the ceramic industry is traditional and has a significant market, and the jewelry industry shows a steady growth trend. According to Statista data, the global jewelry market revenue will reach 310.9 billion in 2024 and maintain a high compound annual growth rate of 3.53%. Driven by a series of China's economic consumption policies, the demand for the jewelry market further expands, and jewelry will become the fastest-growing category in all commodity retail categories in 2023 (National Bureau of Statistics of China, 2024). This growth is mainly due to the improvement in consumer purchases and the trend of aesthetic demand for jewelry, become an indispensable part of people's daily lives. However, jade, diamonds, and other resources are rare, and the price has risen seriously; the reserve of precious jewelry materials is decreasing (WPIC, 2023). The mining of precious jewelry materials requires much energy and labor and will cause serious damage to the environment, and research on alternative materials is carried out to achieve resource conservation and environmental protection. Jewelry design is in constant pursuit of innovation, and contemporary jewelry is no longer limited to the application of materials, which has inspired artists to design ceramic jewelry.

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Although many creative designs of ceramic jewelry are available on the ceramic market, few are made from Zisha clay. Zisha clay is a unique type of pottery clay, and the primary type of clay is a dark purple hue. Zisha pottery has existed since the Song Dynasty in the 10th century AD, as evidenced by fragments of Zisha pottery excavated in Yixing, China, in 1976 (Wang Yiping, 2013). Zisha pottery was developed during the Ming Dynasty (1368-1644 A.D.) and continues to today, with the most common type of Zisha pottery being the Zisha teapot (Zhu et al., 2019). Since the discovery of Zisha clay has become the most suitable material for tea set in China, it is a practical vessel as well as artwork that can be appreciated, and its production craft has been listed as a national intangible cultural heritage, with humanistic and artistic values (Juan Wu et al., 2013). Currently, practitioners of Zisha pottery also focus on Zisha tea sets, with little attention paid to developing other types of Zisha products, which is not conducive to fully exploring and innovating the cultural heritage of mankind. Understanding the cultural background of Zisha and the industry's current state, seizing the opportunity of Zisha's development, and exploring the application of Zisha clay in jewelry design is of great significance to the development of the environment, culture, and art.

The objectives of this article is to discover and tap the application potential of Zisha clay and inject fresh and innovative thinking into traditional ceramic and jewelry forms. This research will verify the chemical composition, physical properties, and aesthetic characteristics of Zisha clay to explore and analyze its potential as a sustainable and environmentally friendly alternative to traditional jewelry materials.

2.0 Literature Review

The design process is a creative activity whose purpose is to determine the quality of various objects and processes throughout the human life cycle. Most designs take into account the diversity of factors such as strength and aesthetic value based on an in-depth study of materials (Siti Suhaily et al., 2019). The research on Zisha's strength and aesthetic value can provide a basis for its application in jewelry design. This article will explore these factors as a potential material for jewelry design. In the traditional craft of Zisha clay tea ware, the clay material, tools, and production process follow the experience and procedure (Yu Xianping, 2022). With its standard, accurate, and elegant plastic art, Zisha pottery shows a unique aesthetic feeling of plastic craft. In jewelry design, the shape of jewelry originates from the reasonable and ingenious combination of point, line, surface, geometry, natural form, and space, creating a variety of shapes (Li Fang, 2020). The symmetry and coordination in jewelry design, the lines, colors, texture, and the virtual space can all constitute different visual effects. Comprehensive materials are one of the popular elements in contemporary society, contemporary jewelry is not restricted by the craft and attaches expression of emotion and material aesthetics. The application of ceramic materials in jewelry design has a unique aesthetic experience (Zou Xiaowen, 2023). Different from other ceramic materials, Zisha can be made into pottery alone without glaze, which can achieve the ultimate in shape and decoration (Jiang Yongjun, et al., 2023). There are many possibilities for the development of Zisha technology, and cross-border cooperation can inject new vitality into jewelry creation (Jiang Feifei, 2024). The combination of Zisha clay and metal, silk, and other materials in jewelry design, using the characteristics of different materials to complement the way of creation, can broaden the performance and diversity of jewelry.

Based on studying the aesthetic of jewelry design, factors such as environmental protection and the safety of materials can be considered to improve people's acceptance. The importance of ecological awareness and the concept of sustainable development has been widely recognized in various industries. Product design needs to fully consider the impact on resources and the environment, reduce pollution, and achieve a harmonious coexistence between humans and nature (Cao Tianhui, 2017). Therefore, for jewelry design, we must first make good choices of materials, naturally pollution-free, reused, recycled, and simple design. Zisha clay is a naturally occurring clay formed over thousands of years by natural weathering and oxidation processes. Today, new technologies help to improve the efficiency of resource utilization and reduce waste, and through reasonable exploitation and utilization, can ensure a sustainable supply of purple sand without excessive depletion of natural resources (He Jiayi, 2022). The adhesion of Zisha clay is very strong, so it is not easy to crack during the production process, and the mud is not sticky hands will not be dusty, so it maintains the cleanliness of the pottery environment. The waste soil produced in the production of Zisha clay and the broken pottery pieces after firing can be recycled. Zisha clay has the advantages of stable composition and no complicated pretreatment (Hao Yaorui, 2022), any shrinkage and deformation rate, and will not change due to the production or firing process (Jian Zhu et al., 2019). Zisha clay only needs to be fired through high temperatures, without adding and generating chemical substances, and no industrial wastewater, waste gas, or garbage. It avoids the generation of toxic and harmful substances and does not affect the environment. However, a combination of a single Zisha clay or compliant clay with naturally colored mud or metal oxides will not cause harm to human health (Wu Yamin, 2024). These characteristics make Zisha clay a choice advantage for making Zisha jewelry, which reflects the value of environmental protection.

By reviewing the literature on jewelry design and Zisha clay, it was found that there is a lack of connection between the two. This study analyzed the feasibility of Zisha clay as a jewelry material based on its environmental protection, molding, and firing stability. Compared with traditional jewelry materials, analyzing and designing Zisha clay as a new jewelry material provides a new perspective for the sustainable development of Zisha clay in the jewelry industry.

3.0 Methodology

The objective of this article lies in analyzing the material and craft of Zisha clay utilized in jewelry design, and applying diverse methods to analyze the chemical composition, physical properties, aesthetic characteristics, and craft molding of Zisha clay, thereby facilitating the discovery of appropriate approaches for developing Zisha jewelry, which is conducive to expanding jewelry product types.

3.1 Chemical composition test

This study collected four kinds of Zisha clay samples, namely purple clay, red clay, Zhu clay, and green clay. The EDX8000 energy dispersive X-ray fluorescence spectrometer (XRF) of Suzhou Real Spectrum Instrument Co., Ltd. was used to test the chemical composition of different types of Zisha clay (Table 1). Use the data to analyze the advantages of the chemical composition of Zisha clay on the molding of Zisha jewelry.

3.2 property test

Test Zisha pottery, ordinary pottery, and porcelain firing at different temperatures, compared with shrinkage ratio, average porosity, and water absorption. The testing instrument was used to observe and analyze the pore distribution of samples with the SEM 8000 China electron microscope, and the porosity was determined by the water boiling method (Table 2). Test the property of Zisha and analyze whether it has the advantage of being a potential material for jewelry.

3.3 Comparative test with other jewelry materials

The density, hardness, and strength of the fired alabaster samples were tested against other jewelry materials such as pearl, diamond, gold, silver, jade, and coral, and the density and hardness of these materials were collected. The strength of the different materials was measured by the SGW Strength Tester Flexure Tester produced by China Instrument Co. Ltd. (Table 3) to explore the rationality of using Zisha clay as a potential material for jewelry design.

3.4 Aesthetic characteristics analysis

Through literature, field research, and collection of various colors of Zisha clay after firing pottery (Fig. 2), then analyzed whether the color and texture beauty of Zisha clay is suitable for the jewelry design aesthetic.

3.5 Craft methods

The craft starts with cutting the clay sheet, using the hammering method to extrude the bubbles and pat out the thickness needed for the jewelry, making various shapes according to the design (Fig. 1), and giving the body a smooth or rich texture. Punch holes or reserve a fixed outline for the jewelry blank and combine it with the material for easy wearing after firing. The produced body is dried naturally, and then it is put into the kiln after drying, and the firing temperature is about 1100 degrees. The color of the fired Zisha is monochrome, it can use special gold water to draw, make it shiny and decorative, and then put into the kiln for a second firing, the temperature is about 750~800 degrees, to make the painted gold water never firm and not discolored, and use an agate pen to polish it to become shiny. The last step is to use a comprehensive material, silk or metal assembly, for decorative beauty and to give Zisha jewelry the function of wearing.



Fig. 1. (a) Cutting; (b) Shaping; (c) Gilding; (d) Re-firing; (e) polishing; (f) Install.
(Source: Personal Photo Archive, 2024)

4.0 Findings

4.1 Chemical composition

Table 1. Types and chemical composition of Zisha clay(wt%)

Samples	MgO	Sio2	MnO	CaO	TiO2	Na2O	Al2O3	FeO2	K2O
Purple clay	0.57	58.39	0.1	0.25	1.08	0.06	20.12	8.38	3.38
Red clay	0.77	49.96	0.005	0.22	1.05	0.11	16.24	18.96	18.96
Zhu clay	0.54	26.63	0.19	0.16	0.68	0.05	10.40	49.31	1.62
Green clay	0.46	58.32	0.006	0.41	1.07	0.07	24.13	1.91	2.01

(Source: Data from tests, 2024)

Through analysis (Table 1), the content of Sio2 is very high, accounting for about 50%, and is sandwiched in the mud in the form of sandy quartz, part of it becomes the skeleton of the Zisha and is not easy to deform. The other part generates glass material at high temperatures, which fills between the skeletons of the body, increases the density, and helps the Zisha jewelry to be strong. Al2O3 makes it easy to generate mullite crystals, increasing the firing temperature, expanding the sintering range, and giving the Zisha a stable and beautiful physical state. CaO plays a fluxing role; the high content of glass material means that the fired Zisha has a good watercolor effect, making the Zisha jewelry rich in color. Sio2, Al2O3, and FeO2 make the Zisha clay have excellent plasticity and can accurately produce Zisha jewelry with various shapes and textures. Therefore, different chemical components affect production and firing and have different physical properties. Good plasticity, high strength, stability, and beauty provide suitable conditions for jewelry design.

4.2 Material properties

Table 2. Shrinkage, porosity, and absorption of Zisha samples, ordinary pottery, and porcelain

Samples	Firing temperature (°C)	Shrinkage ratio after firing (%)	Average porosity (%)	Water absorption (%)
Purple clay	1150	5~6	10.79	2.7
Red clay	1100	10~13	11.61	2.0
Zhu clay	1040	18~27	9.95	1.6
Ordinary pottery	950	10.5	18.32	11.8
	1000	11.6	17.68	11.1
	1100	12.3	17.27	9.5
Porcelain	1200	5.3	2.61	0.23
	1280	6.5	2.45	0.2
	1300	7.8	2.39	0.16

(Source: Data from tests, 2024)

After analyzing the data (Table 2), we found that among similar types of pottery or porcelain, Zisha samples have a lower shrinkage and average absorption rate than ordinary pottery and have a compact structure with abrasion resistance and strength. Compared with porcelain, the average porosity of Zisha samples reaches about 11%, which allows Zisha pottery to maintain good air permeability. The water absorption rate of Zisha samples is around 2%, which is more hygroscopic than the average 0.2% of porcelain. These advantages can make Zisha jewelry more breathable and comfortable to wear, less prone to odor, and when touching, the skin will become smooth with longer wearing time.

4.3 Comparison with other jewellery materials

Table 3. Comparison of density, hardness, and strength of Zisha samples with other jewelry materials

Types	Density ρ (kg/m ³)	Mohs hardness (HM)	Strength (MPa)
Zisha clay	2.5-3.0g/cm ³	5.5~6.5	47.8
Pearl	2.60~2.85	2.5~4.5	6.0~7.0
Diamond	3.52	10	450
Gold(Au)	19.32	2.5	110~120
Silver(Ag)	10.49	2.5~3	180
Jade	2.65-2.75	3-7	100
Coral	2.6~2.7	3~4	1.10~38.56

(Source: Data from tests, 2024)

The test results show that the density of Zisha is similar to that of other jewelry materials such as jade and coral (Table 3). Although its density is lower than that of diamonds, gold, and silver, its hardness is higher than that of other jewelry materials except gemstones, which shows that Zisha has considerable hardness. The hardness of Zisha is related to its unique sandy rock structure. It is hard, moisturized by water and sweat, and becomes smoother and wear-resistant without discoloration when it encounters dust or frequent friction with the skin. This is also the unique feature of Zisha as a jewelry material. The sandy structure gives Zisha a higher strength and can withstand moderate impact, and the smaller the volume of Zisha, the safer it is. Compared with Zisha teapots, Zisha jewelry is less likely to break, which has the characteristics of being a jewelry material.

4.4 Aesthetic characteristics

Currently, according to the appearance and color of Zisha clay, the raw materials of purple clay are classified into purple clay, red clay, and Duan clay. Purple clay is chestnut, brown, and cinnabar purple after firing; red clay is red, scarlet, vermilion, and light red after firing; Duan clay presents different shades of yellow after firing. Zisha clay can also present different color tones of clay depending on the air humidity and firing temperature. In addition, when the creator mixes several clay materials or adds natural oxide colorants, it will produce more colors, such as crabapple red, blue, yellow, dark green, etc. Zisha clay presents a simple and natural color after firing, which is also a good choice for making jewelry with a personalized style. It is also worth mentioning the texture. The main minerals of Zisha clay are quartz, mica hematite, etc., which tend to have more sand and less mud, and good touch is enhanced after firing. Zisha clay has plasticity; with the help of leather and other tools, ground Zisha clay to a smooth texture. Using the tools can create the texture of trees, and adding steel sand and other materials will produce a shimmering texture after firing. The advantage of Zisha clay, which is different from other jewelry materials, is that the texture will become more moist and beautiful after long-term use.



Fig. 2. (a) Color; (b) Texture.
(Source: From the Internet and the Studio, 2024)

4.5 Crafting results

As shown in the figure (Fig. 3), Zisha has been successfully applied to jewelry design through creation. The production of Zisha jewelry integrates the traditional Zisha craft with the unique techniques of individuals and makes Zisha clay into various jewelry shapes. The design and shape of Zisha jewelry are straightforward, reducing the consumption of natural resources, with a simple way to express the beauty of natural materials. This exploration time of Zisha jewelry is short, and more studies are still needed to verify it.



Fig. 3. (a) Tiger Zisha jewelry; (b) Plant motif Zisha jewelry.
(Source: Personal Photo Archive, 2024)

5.0 Discussion

Through exploration and analysis, it is found that Zisha has high hardness, wear resistance, and strength, so the fired Zisha jewelry is not easy to damage, can persist in a variety of environments to maintain its beauty, and practicality to avoid long-term wear caused by jewelry fading, oxidation, grinding, and other adverse problems, thereby reducing the frequency of replacement of jewelry, avoid wasting resources. The appropriate porosity and water absorption characteristics make Zisha jewelry comfortable to wear and emit a naturally quaint luster. The plasticity of Zisha clay provides good craft conditions for various shapes and promotes the delicate and diverse appearance of Zisha jewelry, the performance of the texture effect reflects the creator's mastery of materials and craft and the accurate expression of artistic intuition.

In the process of exploration and practice, it is also found that Zisha clay has natural environmental protection characteristics, craft, and cultural inheritance, design of new ideas will enhance the value of jewelry products, reflecting more advantages and inclusiveness, worthy of discussion, so, Zisha jewelry has a large design and creation space. Although the current jewelry materials are very diverse, but precious jewelry materials are relatively rare and expensive, and in contemporary comprehensive material jewelry, some easily obtained materials such as iron, plastic, gypsum, or wood are easier to cause oxidation, discoloration, or pollution and other problems are not widely used in the jewelry industry. In recent years, the pollution of some industries has made human beings pay more attention to the problem of living environment, advocate environmental protection, and reduce the excessive processing and waste of resources. With the growing trend of ecological awareness in product design, the continuous addition of new environmentally friendly materials will provide people with new aesthetic objects. Zisha clay is derived from nature, has pollution-free and sustainable characteristics, and is friendly to people and the environment. The pottery jewelry originally modeled on natural forms in ancient times has returned to the theme of natural ecology. China attaches great importance to the inheritance and development of intangible cultural heritage and craft, which provides new opportunities for the traditional ceramic and jewelry industry. Under the support of culture, art, and technology, the application of Zisha clay in jewelry design has cultural, aesthetic, and environmental value.

In this study, through continuous efforts and attention, Zisha clay as an alternative material for jewelry design, to provide people with new aesthetic objects and get more attention, development, innovation, and promotion. However, compared with traditional jewelry materials, the color of Zisha clay is too dull, and the application and challenge of new jewelry design materials are still in progress. Improving more abundant art forms can enhance the charm of Zisha jewelry and increase its consumer groups.

6.0 Conclusion and Recommendations

The chemical composition, permeability, hygroscopicity, density, hardness, strength, and aesthetics of Zisha clay are analyzed and explored to meet the requirements for making jewelry, reassuring people that Zisha clay's environmental, safety, quality, durability, and aesthetics can be used as an alternative material for jewelry design, and identifying that it can be compared to other types of jewelry materials. The presented methodology of the individual's practice, and the showing final rendering of the Zisha jewelry, whereby the material, primarily used as a pot-making material, is designed and created to be transformed into delicate and minimalist jewelry. The availability of Zisha clay at a reasonable cost will bring new developments in the design and creation of jewelry, and the research objectives were all achieved. This research, the chemical composition, physical properties, and aesthetic characteristics of Zisha clay, this research explores the diversity and beauty of Zisha clay in jewelry design, which can ensure the feasibility of using Zisha clay as an alternative raw material for jewelry, and provide references for Zisha clay potters and jewelry designers. In the future, we will further study the long-term durability of Zisha jewelry, create more artistic forms of Zisha clay in jewelry design, consumer perceptions, and encourage users to adopt a sustainable lifestyle and jewelry design in a variety of innovative ways. At the same time, explore the potential uses of Zisha clay in other industries, promote the development of new uses of Zisha clay, and continue to innovate to open new markets.

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Paper Contribution to Related Field of Study

From the perspective of jewelry design, the composition, properties, aesthetics, and craft of Zisha clay are discussed; Zisha clay is more accessible and environmentally friendly than traditional jewelry materials. However, its recognition in the field of ceramic jewelry still needs to improve. This study has reference value for promoting the development of the creative industry.

References

- Bilgili, B., Ercis, A., Ünal, S. (2011). Kano model application in new product development and customer satisfaction (adaptation of traditional art of tile making to jewelries), *Procedia Social and Behavioral Sciences*, 24 (2011) 829–846.
- Duangkhachon, K. & Kamon, O. (2018). The Development of Dan-Kwian Ceramic Jewelry for Contemporary Aesthetics in Nakhon Ratchasima Province. *Key Engineering Materials*. ISSN: 1662-9795. Vol. 766, (pp 44-50). doi:10.4028/www.scientific.net/KEM.766.44.

- Gowlland, G. (2016). Style, Skill and Modernity in the Zisha Pottery of China. *The Journal of Modern Craft*. ISSN: 1749-6772 (Print) 1749-6780 (Online) Journal homepage: <http://www.tandfonline.com/loi/jfmc20>. 129-141.
- Kutsenko, L. E. & Arventyeva, N. A. (2017). Mixed technologies of artistic ceramics processing for jewelry manufacture. *International Conference on Information Technologies in Business and Industry. Series: Journal of Physics: Conf. Series* 803 (2017) 012087. doi:10.1088/1742-6596/803/1/012087.
- Lingling, J. (2015). Brief description of the craft characteristics of purple clay and purple clay pottery.
- Mahendri, C. D., Anggoro, P. W., Fergjawan, P. K., Yuniarto, T., Bayuseno, A. P., & Jamari. (2020). Development of the Ceramic Jewelry Industry for Necklace with Indonesian Batik Motifs. *Advances in Engineering Research. Proceedings of the 2nd Borobudur International Symposium on Science and Technology (BIS-STE 2020)*.
- Minglong, M. (2011). The role of purple clay and its influence on color. *Foshan Ceramics*.
- Mishra, S. P., Gujar, U. S., Das, L. K., Bansod, L., & Bhalshankar, S. P. (2013). Natural Colours for Terracotta Jewellery. *International Journal of Scientific and Research Publications*. ISSN 2250-3153 ,www.ijsrp.org.
- Onal, P.B. (2012). Op-art and personal practices in contemporary ceramic art, *Procedia - Social and Behavioral Sciences*, 51 (2012) 655 – 661.
- Stamatia, V., Antonopoulou, G., Azariadis, P., Fudosa, I. (2011). A parametric feature-based approach to reconstructing traditional filigree jewelry. *Computer-Aided Design*, 43 (2011) 1814–1828.
- Suhaily, S. S., Gopakumar, D. A., Aprilia, N. A. S., Rizal, S., Paridah, M. T., and Khalil, H. P. A. (2019). Evaluation of Screw Pulling and Flexural Strength of Bamboo-base Oil Palm Trunk Veneer Hybrid Biocomposites Intended for Furniture Applications. *Bamboo hybrid. BioResources* 14(4), 8376–8390
- Thompson, F. (2011). Producing ceramic art works through tourism research. *Annals of Tourism Research*. Vol. 39, No. 1, (pp. 336–360), 2012 0160-7383/.
- Tianhui, C. (2017). Green life, sustainable design. *Popular Literature and Art*, (19): 101-102.
- World Platinum Investment Council (WPIC). (2023). *Platinum Quarterly*.
- Wu, J., Hou, T., Zhang, M., Li, Q., Wu, J., Li, J., Deng, Z. (2013). An analysis of the chemical composition, performance and structure of China Yixing Zisha pottery from 1573 A.D. to 1911 A.D.. *Ceramics International*, 39 (2013) 2589–2595. <http://dx.doi.org/10.1016/j.ceramint.2012.09.021>.
- Xiaowen, Z. (2023). *Ceramic jewelry design and production*. Nanjing: Jiangsu Phoenix Art Publishing House. ISBN 978-7-5741-1003-9.
- Yang, A. (2016). *Jewelry Materials Application Guide*. Shanghai People's Publishing House, ISBN:9787532265336.
- Zhiwei, C. (2013). On Yixing purple clay. *Market Weekly*.
- Zhu, J., MacDonald, B. L., Hang, T., Zhu, Z., Glascock, M. D. (2019). Compositional characterization of Zisha clay from the Yixing area (Jiangsu, China) by neutron activation analysis. *Microchemical Journal*, 147 (2019) 1117–1122.
- Jiang Yongjun, He Jiao Yue. (2023). Research on the application of purple sand material in jewelry field. *Ceramic science and art*. ISSN:1671-7643. CN: 43-1375/TS
- Jiang Feifei. (2024). Zisha crafts future development prospects. *Shanghai light industry*. ISSN:1004-3772
- A surname. (2022). Analysis of Yixing purple sand technology. *A taste of art*. ISSN:2095-2406, CN:61-1485/J
- He Jiayi. (2022). Research on the evolution history of Zisha clay material in Yixing. *Ceramics*. ISSN:1002-2872, CN:61-1143/TU