Fabrication of Ceramic Jewelry Coated with Thermochromic Powder-Embedded Resin

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Introduction

Ceramic materials have been widely used since ancient times due to their durability, heat resistance, and versatility in forming various shapes and surface textures. In recent years, ceramics have gained increasing attention in the jewelry industry because of their unique aesthetic properties and lightweight characteristics. Among ceramic materials, porcelain and stoneware are commonly used due to their strength and stability after firing. However, the suitability of these materials for small-scale jewelry applications requires further investigation, particularly in terms of firing conditions and microstructural properties. Therefore, this study aims to compare porcelain and stoneware ceramic clays for handmade jewelry production and evaluate their microstructure and composition using SEM-EDS analysis.

Materials and methods

Porcelain and stoneware clays were prepared and fired for 7, 9 and 12 hours to produce experimental jewelry (Figure1). After firing, the samples were coated with epoxy resin mixed with thermochromic pigment powder. The microstructure was examined using microscopy and SEM, and elemental composition was analyzed by EDS.



Figure 1 : Image of ceramic jewelry samples after firing. Porcelain (left) and stoneware (right) showing ring (top) and pendant (bottom) forms.

Results

Microscopic observation (Figure2) showed that the porcelain sample had a smooth and dense surface with fine particles. In contrast, the stoneware sample showed a rougher surface with visible pores, indicating a less compact structure.

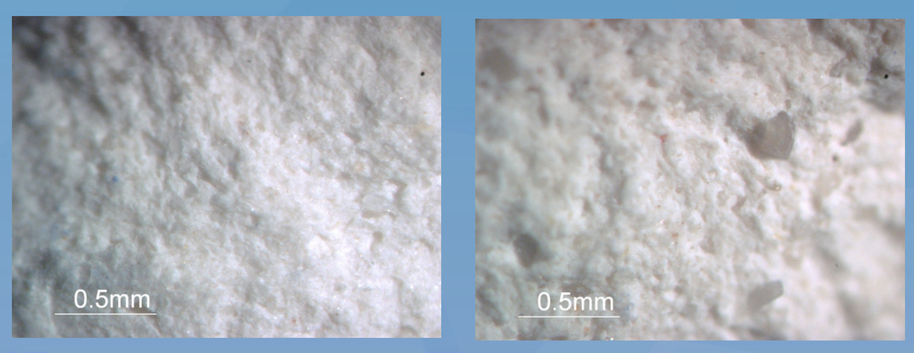


Figure 2 : Microscopic images of fired porcelain (left) and stoneware (right) samples showing differences in surface morphology and microstructure.

Chemical analysis

SEM images (Figure 3) of the porcelain sample showed a relatively dense microstructure with fine and uniformly distributed particles. Some pores were still present within the ceramic body. The area labeled Spectrum 13 was selected for EDS elemental analysis (Table1).The scale bar represents 100 μm.

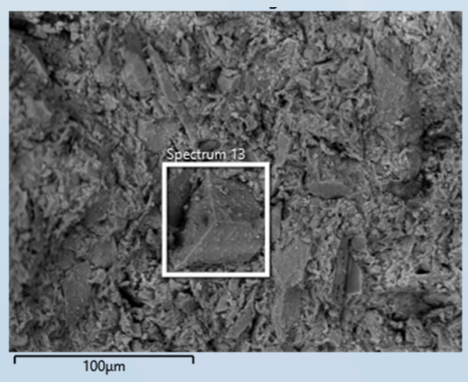


Figure 3 : SEM images of porcelain sample showing porous microstructure after firing at 950 °C

Table 1 : Results of SEM-EDS chemical analyes (all values quoted in wt% oxide)

Element	Wt%	Atomic %	Oxide	Oxide %
C	5.38	8.45	CO_2	19.72
O	55.64	65.58	-	-
Na	0.19	0.16	Na_2O	0.26
Al	7.17	5.01	Al_2O_3	13.55
Si	30.15	20.24	SiO_2	64.5
K	0.35	0.17	K_2O	0.43
Ti	0.32	0.12	TiO_2	0.53
Fe	0.79	0.27	FeO	1.02

Conclusion

The results show that both porcelain and stoneware clay can be formed into ceramic jewelry by fired at 950 °C. SEM-EDS analysis indicated that silicon (Si) and aluminum (Al) were the main elements, representing typical aluminosilicate ceramic composition. The microstructure showed some porosity, suggesting incomplete densification at this temperature. After firing, the samples were coated with resin mixed with thermochromic powder, which improved surface appearance and added temperature-responsive color-changing properties. Therefore, these materials are suitable for lightweight decorative ceramic jewelry applications.

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