Formal Transformation and Conceptual Expression of Firing Traces in Modern Ceramic Art

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Abstract: *Firing traces in modern ceramic art is usually considered as firing defect but can also be used separately on form language and concept expression. Generative logic of thermodynamic imprints, natural textures, shrinkage cracks were analyzed through three aspects (material basis, formal reconstruction, and conceptual projection); the abstraction of traces, time superimposition, and the dialectical relationship between uncontrolled traces and order have been further explored; furthermore, the meaning of traces as evidence of process, the aesthetics of imperfection as a carrier of contingency, and the translation of symbolization and individual memory have been elucidated. We have proven that formal transformation of firing traces depends on a hierarchy of materiality to grammar and then to metaphor providing ceramic art with its own surface language system different from glaze painting and sculpture.*

Keywords: *modern ceramic art, firing traces, formal transformation, visual grammar, conceptual expression*

Introduction

Firing traces are these spontaneous physical imprints left on the surface of clay bodies caused by temperature, atmosphere and cooling processes inside the kiln (fire marks, ash-glaze deposits, cracks, melt holes, smoke stains) that were hidden or removed through traditional ceramic craftsmanship in order to achieve its surface's uniformity and completeness. But with the evolution of modern ceramic art, these traces – once considered defects – have been gradually transformed into valuable formal resources. We need to do so because firing traces can reflect the interaction process between fire and clay, having a sense of material authenticity that is not substitutable by any artificial depiction. They stay in a state of contingency if untouched by being transformed; if totally eliminated, we will lose the unique process language specific to the ceramic medium. There must be a systematic methodology to discuss how firing traces transform from natural phenomenon to formal organization and then becomes vehicles of conceptual expression. This paper aims at tackling this key problem of formal transformation and conceptual expression and elaborated from three aspects — material basis, visual grammar transformation, and metaphorical projection, trying to build up a complete logical chain from generation to signification for firing traces.

1. Material Basis and Formal Generation of Firing Traces

1.1 Thermodynamic Imprint Characteristics on the Clay Body Surface

1.1.1 Surface Deformation Records during the Dehydration and Sintering Stages

Initial heating discharges absorbed water and crystal water inside the clay body one after another which results in arranging the particles and opening/closing of microcracks with shallow linear/reticular surface lines; At the temperature of sintering, low melting point components start melting and moving toward the surface by capillary action creating glassy patches or local reflective area upon cooling. Thermal action makes the clay go from a loose state towards densification, keeping undulations and color difference in its transitional state on the surface[1].

1.1.2 Bubble Bursting and Melt-Hole Structures Caused by Local Overheating

Spike at temperature usually happens close to a kiln wall or stoking port reduces the viscosity of the liquid phase in the surface layer of the clay body; the internal gases expand and burst out from the surface as open pores or melt holes. Size (diameter), depth and rim shape depends on degree of superheating and surface tension of the liquid phase. Melt holes can partially be filled up with further flows of melts creating concentric solidification ripples, not an addition of pits – they are natural residues when thermal forces exceed the material's tolerance threshold.

1.1.3 Differential Thermal Responses of Different Clay Mineral Components

The relative amount of quartz, feldspar and kaolinite in clay affects the look of thermal imprints: Fine crackle pattern from high-quartz when rapidly cooled; extensive molten spreading caused by high-feldspar. Higher iron-titanium oxide leads to dark brown to black scorch spots (oxidizing atmosphere) or grayish-blue tones (reducing). The composition dependent character implies that thermodynamic imprints are not accident blemishes, they are a thermal history manual written by the material itself.

1.2 Natural Texture Forms of Fire Marks and Ash Deposits

1.2.1 Linear and Banded Accumulation Patterns Controlled by Flame Flow Direction

If the flame sticks onto the surface of the clay body, the drag of melt and ash follows the airflow direction resulting in long lines/bands; thick collection on one side (facing the flame), and relatively clean/with dot like attachments on another side (away from the flame). Directional features give fire marks a pointing function as brushstrokes suggesting the flow of hot air inside the kiln. Orientation of an object has great difference in density and direction of fire marks creating a non-artificial surface rhythm in the sense of fluid mechanics[2].

1.2.2 Color Layer Differences and Halo Effects under Reducing and Oxidizing Atmospheres

Under a reducing atmosphere carbon monoxide reacts with iron elements on the surface layer of the clay body forming halos of colors ranging from grayish blue, bluish brown or purplish gray; under an oxidizing atmosphere – mainly dot- and strip-like accumulations in warm yellow, ochre red or orange hues. Alternating changes of atmospheres result in overlapping boundaries of color layers on one surface with blurred edges of halo effects and natural transition. Color layers are not flat pigments applied, but traces left by the atmosphere as if it is working like an invisible brush which repeatedly wips between the glaze and the clay body.

1.2.3 Textural Gradation from Coarse to Fine Based on Ash Particle Size and Viscosity

Particle size ranges from submicron soot to millimeters large coarse grains; viscosity depends upon their melting temperature – fine ash has a smooth thin layer with a silky luster whereas coarse grains form granular or nodular glaze deposits which have rough surfaces and diffuse light reflection. The different sized ash particles stick together forming layers (fine layer below and coarse above) creating a textured profile like sedimentary rock. A gradational texture indicates that there are successions of abrasion of this surface by sands of different coarseness without any sense of regularity typical for artificial polishing.

1.3 Shrinkage Cracking as a Structural Formal Element

1.3.1 Reticular and Radial Fine Cracks Induced by Imbalance of Internal Stress

In case when the thickness of the clay body has an unevenness and some places have an obstruction for shrinkage, the internal tensile stress produces dense reticular cracks or crack lines radially outwards from stress concentration points. Reticular cracks looks like mud cracks of a dried riverbed; it consists of fine lines which are connected all over. Radial cracks scatter outwards from one center, increasing distance as they spread. They don't go through the whole body just stay within the surface layer creating a visual appearance like broken glass that hasn't come down. Distribution density of these cracks is proportional to the stress gradient - the higher the stress, the denser the cracks[3]

1.3.2 Through-Going Wide Cracks Caused by Rapid Cooling and Their Boundary Morphology

If the cooling rate is higher than the thermal shock tolerance limit for the clay body then cracks are initiated at edges/holes/transitional zones between thick/thin section resulting in wide through going cracks which usually go through the whole wall thickness with sharp boundary and few branches; In the late stage of cooling both walls of the crack can slightly dislocate creating a stepped cross-section profile. The wide crack breaks the total continuity of the surface giving an amazing linear segmentation effect by sharply slicing into the previous smooth curved surface with a deep groove.

1.3.3 Formal Tension between Controllable Pre-Damage and Uncontrollable Propagation

Changing the amount of grog in clay formulae; changing the wall thickness distribution of the formed body; or local groove on its surface we can preselect the overall range and direction of cracks to some extent. But the exact position, length and branching points for each final crack is chosen autonomously by thermal stress: The mixture between predetermination and randomness makes cracking not only having a design intention but also has the vividness of contingency. Cracks' tips often end up in hair-like ends whose spreading tendencies cannot be predicted completely which preserves the material's own voice under a rational framework.

2. Formal Reconstruction of Trace Morphology and Visual Grammar Transformation

2.1 Methods of Abstracting Firing Traces

2.1.1 Scale Enlargement of Ash-Glaze Deposits and Independence of Their Contours

Magnify a spot with ash-glaze deposits several times and see blurred grain boundaries with porous structure similar to volcanic scoria or foam. Different shapes of openings, wall thicknesses and interconnections mode for each pore we extract separately in closed or open graphics not tied up at their original position of ash accumulation. In plain words: enlarge a small nodule formed during firing into a flat graphic image whose edge lines become protagonists themselves. Independent contours may be used as is or simplified (removing internal stray dots) but keeping outermost trending lines[4]

2.1.2 Curve Extraction and Linear Reconstruction of Fire-Mark Boundaries

There is usually a transition zone between the fire marks and unburned areas whose boundary forms a wavy or zigzag pattern. Choosing some parts of such boundary which have strong undulations; separate it from the original color layer background by closure processing. Curvature variations, distance among the protrusion points as well as depths of indentions on the boundary line carries the velocity information of the flame flow. It can be elongated, compressed or mirror reversed in order to form a series of rhythmically arranged lines after linear reconstruction. So we convert the trajectory of flame licking into an independent placeable linear material.

2.1.3 Morphological Simplification and Unit Categorization of Burst-Stone Pits

The burst stone pit is made by the expansion/explosion of impurities in the clay body under a high temperature. An irregular elliptic shape, it has raised small lip edges around the rim. The burrows/branches will be simplified only keeping the main concave contour and the width of the lip edge's. Different sized pits on one object fall into three scales (small, medium, and large) as different units. Scattered and random pits could assemble and combine together like standard parts to make regular surface texture.

2.2 Temporal Manifestation through Repeated Superposition and Stratification

2.2.1 Multiple Applications and Density Accumulation of the Same Type of Trace

I repeat such a trace (e.g., smoke stains) on the same area with two or three kiln firings under similar firing condition and atmosphere; each new smoke layer covers some part of the previous one but due to temperature fluctuation it doesn't completely cover so that the edge of the old layer faintly shows up underneath the new layer. We keep accumulating the color depth of an area as well as increasing its blurriness too. The density accumulation is not just a color overlay, there are always irregular uncovered gaps between every layer which creates a breath like variation in density.

2.2.2 Overlap Order and Interfacial Reaction of Heterogeneous Traces

We may use in succession two kinds of traces of different nature (for instance: first ash-glaze deposits followed by reduction fire marks). The second firing, because of its reducing atmosphere, adds bluish-gray halos over the existing glaze surface together with an interfacial reaction with the first ash-glaze deposits changing their gloss or causing some flaking. When using first fire marks and then ash-glaze deposits, they will cover parts of the previous ones blurring them. Order of overlap determines the legibility of layers on the surface; junction between these two kinds of traces usually creates a new kind of trace.

2.2.3 Selective Appearance of Traces after Masking and Uncovering

We cover some areas using refractory materials (temporary coatings), so that traces from the next firing will appear only if they are not masked. Taking off the masking brings about juxtaposition of the old traces and the new ones creating a feeling of time leap – e.g., a big area of smoke stains from the first firing is partially covered; the second firing has created new melt spots in these covered areas, however, the original smoke stains remain visible only in the unmasked areas. Selective appearance allows us to have two groups of traces belonging to different periods coexisting on one surface with clear boundaries[5].

2.3 Dialectical Relationship between Uncontrolled Traces and Ordered Forms

2.3.1 Containment of Uncontrolled Traces within Geometric Boundaries

We make surfaces on the clay body using clay slabs or molds of regular grids, concentric circles and linear grooves – in our firing we let uncontrolled traces (drips, bubbles, or melt holes) happen. Physical geometric boundaries block or redirect the uncontrolled traces going towards the edges which limits its scope into neat cells; the random accumulations inside each cell contrasted by straight boundary lines, yet the uncontrolled traces acquire a permitted chaos within an order framework.

2.3.2 Embedding of Ordered Strips on Free-Form Surfaces

For curves with dominant uncontrolled traces (extensive smoke stains and drips), we apply refractory materials on some straight strip areas that will stay light colored/undamaged after firing, interlaced uniformly by width and interval over the chaotic surface. The edge usually has fine serrations from incomplete masking giving us a hint of uncontrolled traces as well as providing stable reference points for our eyes.

2.3.3 Alternating Juxtaposition of Uncontrolled Areas and Ordered Grids

Splitting up my surface on the clay body in several parts, alternating between uncontrolled traces and ordered grids as main treatment: often – one section has been treated by high temperature drips, next section - fine incised lines etc. Boundaries of sections are straight, zigzag or wavy lines. Alternating juxtaposing keeps the gaze always changing from randomness and regularity but not dominating over the other system which checks each other creating a visual balance with contradiction existing together.

3. Trace Metaphor and Conceptual Projection of Subjective Consciousness

3.1 Firing Traces as Processual Material Traces

3.1.1 Sequential Coding of Heating and Holding Events on the Surface

The change in the heating rate produces various density microcracks or melt patches at the surface of the clay body; fast heating results in fine and scattered burst points whereas slow heating gives rise to continuous smooth melting zones. The difference in holding duration will produce different area and glossiness for the vitrified areas – the longer the holding time, the spread out the melting completely. They appear one after another by sequence as per the firing order like a kind of sequential coding written on the surface. In other words, it translates the temperature curve into visible lines[6].

3.1.2 Overlap Relationships of Traces and Reverse Deduction of Operational Sequences

The traces of a later firing overlap with those of the previous one. Boundary morphologies of overlapping parts, as well as the level of fusion between the old and new traces, record the time interval and temperature difference between these two firings. Edges of old traces without overlaps preserve their full original shape whereas the overlapped parts become rounded/blurred. Observing the layer on top vs. underneath we can reversely deduce the chronological order of the operations. Overlaps make this surface a stack of compressed layers: every layer preserves traces which have been modified in the previous round of fire.

3.1.3 Surface Storage Mechanism of Non-Textual Process Archives

I do not use written symbols within my trace system; I store information via morphological, chromatic and textured difference. Length of a drip corresponds with the duration of an overheating event whilst the gray scale of a smoke stain corresponds with the concentration of a reducing atmosphere. It's read without translating it into language – you can see the intensity or gentleness of such a process by looking at visual differences. My storage mechanism translates invisible fluctuations inside the kiln as undulations that are visible for all on the surface of a ceramic piece.

3.2 The Aesthetics of Imperfection and the Conceptual Bearing of Contingency

3.2.1 Visual Refutation of the Concept of Completeness by Crazing and Peeling

Crazing or local glaze peeling disrupts the continuity and smoothness of an object's surface; it is not random damage, but caused by the material's own shrinkage stress or mismatching between glaze and body. Edges of fired peeling have a different nature from artificial chipping (rounded, melted), as well as secondary microcrystals formed within the fissures – evidence of this being a direct result of the firing process, not subsequent damage. A work embracing all these imperfections speaks through its physical state: completeness isn't the only option.

3.2.2 Contingency as an Irreproducible Aesthetic Parameter

Cracking direction, peeling shape, or burst bubble density can never be predicted exactly. You can set up conditions for increasing chances of imperfections though there exists a margin of contingency on both ends. The margin ensures that every imperfect work has its own unique outcome – you cannot get exact cracks using the same formula and the same kiln position. Contingency isn't an error it's a special parameter which produces just one result in any given firing. Viewers will see how their work was created by chance during this particular firing.

3.2.3 Reflection on the Boundary of Control Implicit in Accepting Imperfection

We trade off full control on our results (we don't want to be able to achieve regularity) – we choose not to. We shift focus from predetermination towards accepting the feedback from the material and the firing conditions, incorporate it into our work. Imperfectness reminds us that there are undesignable parts of the firing process. To accept them is not a compromise, but an expression of the uncontrollable: The line between control and letting go is marked with the cracks.

3.3 Symbolization of Traces and the Translation of Individual Memory

3.3.1 Isomorphic Correspondence between Radial Cracks and Specific Feelings of Frustration

The radial cracks radiate out from one center becoming increasingly spaced (dense to sparse) lines getting deeper to shallower – giving a feeling that there's a tension stretching from within. Repeating the crack motif over and over with it placed on the stress bearing/visual focus of their work allows us to perceive these artists correspond to the frustration created by losing control of the material. The tensile structure of the cracks has an isomorphic correspondence to the psychological structure of frustration allowing us to see unease via the visual effect of tearing outwardly.

3.3.2 Repeated Appearance of Low-Saturation Smoke-Stained Layers and the Establishment of Symbolic Identity

The huge amounts of gray-brown smoke-stained layers with low contrast and blurred borders (without any directionality), that always appear in a series of works on all the main surface areas, are not only effects from the kiln atmosphere – it has become my personal underlying tone; it shows a state of low energy, slowness, or diffusion. Repetition as direct symbolization: An occurrence happens accidentally but ten occurrences is a choice.

3.3.3 Boundary Control of Translation While Preserving the Origin of Materiality

Symbolization of traces does not go all the way in symbolic substitution (fire marks become abstract icons unrelated to fire), but the limit for translation is keeping traces identifiable as a product of firing – preserving their identity of melting/charring/cracking. Too much change separates them from the kiln process by turning into ordinary graphics that can be made out of any material. Translation makes it possible at once to refer to personal experience: A crack becomes the result of shrinkage stress and an equivalent of memory.

Conclusion

Formal Transformation of Firing Traces Mechanisms of generating materials (dehydration and sintering, bubble and melt holes); directional accumulation of fire marks, difference in atmospheric color layers, and graded textures of ash deposits are visual material; shrinkage cracking brings about an uncontrollable vs controllable tension. The trace reconstruction above materiality realizes the visual grammar transformation: abstraction extraction, time embedding with repeated superposition, dialectic relationship between uncontrolled traces and order. They realize conceptual projection which makes traces become sequential coding and process archives, make imperfection bear the aesthetics of contingency, translate individual memory by symbolization. We may go into new types of traces like salt firing, we may use cognitive neuroaesthetics to quantify viewers' response, or go towards cross-media creation.

References

[1] Qi Xia, and Yuan Lehui. An Exploration of the Expression of Ceramic Formal Language through the Intervention of Spatial Atmosphere. China Ceramics, vol. 61, no. 12, 2025, pp. 99-105.

[2] Fan Xingyu. A Study on Color Expression in Modern Ceramic Art. 2022. Jingdezhen Ceramic University, MA thesis.

[3] Yuan Hong, and Wang Rui. An Analysis of the Aesthetic Values of Modern Chinese Ceramic Art. Art Observation, no. 12, 2022, pp. 65-66.

[4] Liu Xinyu. Chinese-Style Conceptual Expression in Contemporary Chinese Ceramic Art. 2021. Nanjing University of the Arts, MA thesis.

[5] Tan Jingjing. Public Expression of Contemporary Environmental Ceramic Art from the Perspective of Artistic Anthropology. Journal of Ceramics, vol. 42, no. 02, 2021, pp. 343-348.

[6] Zeng Pengde. My Views on Imagery Expression in Contemporary Ceramic Art Creation. Art, no. 05, 2020, pp. 152-153.