

Technical factors affecting the luster and shine development in Islamic metallic luster between (9-15) AD

Assist. Prof. Dr. Nawal Ahmed Ibrahim

Assistant Professor, Department of Ceramics - Faculty of Applied Arts

Helwan University

dr.nawalibrahem@yahoo.com

Research Summary:

Islamic metallic luster is one of the historical Islamic ceramic techniques that appeared in some Islamic states in periods of the century (9-15) AD, it appeared at first in Iraq, then in Egypt, then in Syria and Iran, then in Andalusia (currently Spain). It is a style of ceramic decoration through drawing with copper and silver compounds on the glaze. At first starting with oxidizing fire and we end with reduction to convert the copper and silver oxide to the copper and silver to metal case, which appears in the beautiful mineral image. These resulting colors and their degrees depend on several factors, including the size and quantity of silver and copper particles, the composition of the glaze and fire (atmosphere of the reduced kiln). After studying the historical models of metallic luster products, performing chemical analysis, x-ray analysis, and others, it turns out that the glaze composition used in metallic luster contains lead because it gives the distinctive luster of metallic luster as well as tin that gives opacity in the glaze. The Iraqi metallic luster was distinguished by its multi-colored decorations resulting from the addition of silver and copper in different proportions. Multiple colors appeared, including golden, silver, copper and combinations of brown, ocher, greenish-black, copper and silver-white, and the multi-colored metallic luster did not appear again in Islamic ceramics until it appeared in Italy in the fifteenth and sixteenth century AD, while the Fatimid Egyptian luster was distinguished as monochromatic rich in silver and the colors of green, yellow and metallic brown appeared and they used clay rich in lime. As for the Syrian metallic luster, it was different, it depended on copper, and it appeared ruby red and did not use lead oxide in the glaze, the Syrian metallic luster was less luster than Fatimid, Abbasid and Spanish, as for the Iranian metallic luster was at the same time with the Syrian metallic luster, but it was similar to the Fatimid metallic luster in terms of the intensity of luster for their use of lead-glaze like Fatimid luster, while the Spanish luster used tin glaze with lead-rich and its colors were based on copper like the Iranian luster.

Key words:

Islamic metallic luster, copper, silver, glazes, reduction.

Introduction:

Metallic luster is one of the most famous ceramic techniques among the early Muslims, and its appearance was after the Islam prohibition of eating in gold and silver ware, so Muslim potters resorted to this technique to obtain utensils that have gold and silver luster and are not forbidden to use, which are very thin metal layers on the glaze surface, and this technique was done with ornamentation with copper and silver compounds on white tin and lead fired glazes, then oxidized fire at a softened or molted temperature then transformed into the atmosphere of the furnace from an oxidizing atmosphere to a reduced atmosphere by making the furnace atmosphere contain carbon that is an element that is not stable and needs oxygen to convert to a stable compound, which is carbon dioxide. So he takes oxygen from copper

and silver compounds and turns to luster metallic state that includes multiple colors and many degrees as a result of copper and silver mixing ratios, and differed on the way carbon is present in the kiln. And they differed on the method of the presence of carbon in the kiln, whether from the atmosphere of the reduced furnace or by mixing copper and silver compounds with acetate, and they are the source of reducing the metal oxides in an oxidizing atmosphere of the kiln or both methods.

Research problem:

The desire to study technological and technical factors and their communication throughout these historical periods of Islamic metallic luster which led to the development and prosperity of luster and shine of metallic luster in periods of (9-15).

Research aims:

- Study the factors that led to the development of Islamic metallic luster in the period (9-15) AD.
- Highlighting the importance of this Islamic historical technique to revive it with its previous distinguished aesthetic values.

Research hypotheses:

- There is a strong correlation between Islamic metallic luster technology in Iraq, Egypt, Syria, Iran and Spain.
- The use of copper and silver compounds together in different proportions in the metallic luster gives a great diversity in the resulting colors.
- The use of tin glazes with lead-rich is one of the important factors that led to the development of the Islamic metallic luster.

Search limits:

Pottery with an Islamic metallic luster in Iraq, Egypt, Syria, Iran and Andalusia (present-day Spain) from (9-15) AD.

Research Methodology:

Descriptive and analytical method:

Analytical study:

- The results of chemical and optical analysis on some pieces of the historical Islamic metallic luster showed many of the properties of the metallic luster for each era, so we find the Iraqi metallic luster in the ninth century AD that does not have a metallic luster and that is caused by the percentage of lead oxide in tin glaze from 5 to 15%, and the Iraqi metallic luster in the tenth century AD, the metallic luster of the metallic green color appeared only as a result of the high percentage of lead oxide in the glass paint from 10 to 20% and the development of the metallic luster here due to the high percentage of lead oxide in the glazes, and the Iranian metallic luster the percentage of lead oxide from 20 to 30% Therefore, we find the metallic luster better in luster than the Abbasid, and we find that the Fatimid metallic luster is much more as it appears in the figures from (3-6) because the percentage of lead oxide in tin glaze is more than 30 to 40%, while the Syrian luster does not have a metallic luster due to the use of lead-free alkali glaze as shown in the following figure No. (13) and Table No. (14)

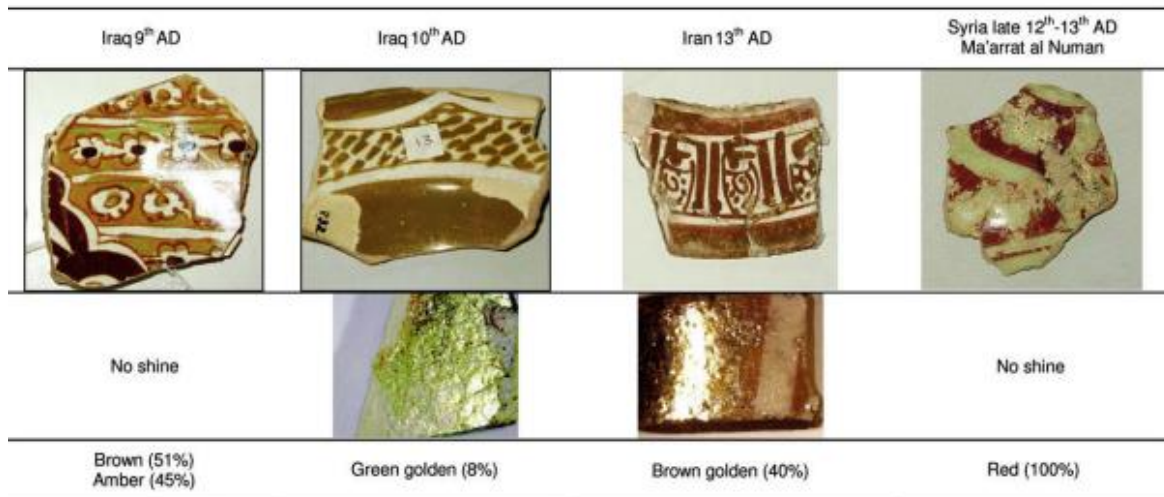


Figure No. (13) Comparison of some parts of the historical Islamic metallic luster in terms of color and luster (4)

General characteristics of the Islamic lustre productions

	Production	Ceramic paste	Glaze ¹	Lustre colour	Lustre shine	%Cu/(Cu + Ag) ²	Nanoparticles ³	Oxidation state ²	
Iraq	9th AD	Polychrome	Fine calcareous	5–15% PbO, tin	Brown-green&amber	Only green golden	40–90	Silver	Cu ⁺ , Cu ²⁺ , Ag ⁰
	10th AD	Monochrome		10–15% PbO tin	Green-yellow	Golden	0–10		
Egypt	11th AD	Monochrome	Fine calcareous	30–40%PbO, tin	Green, yellow, amber	Golden	10	Silver	Ag ⁰ , Cu ⁺
	12th AD	Monochrome	Coarse & high calcareous	25–40%PbO, tin	Yellow, amber, brown	Golden	10–30		
			Stonepaste				10		
Persia	Late12th–13th AD	Monochrome	Stonepaste	20–25%PbO, tin	Brown red edges	Golden	40–60	Silver, copper edges	Ag ⁰ , Cu ⁰ , Cu ⁺
Syria	Late12th-13th AD	Ma'arrat al Numan	Stonepaste	Alkaline, transparent	Red	No	100	Copper	Cu ⁺ , Cu ⁰
	13th AD	Raqqa			Brown, yellow-green	No	70	Silver	Cu ⁺ , Ag ⁰

¹ Microprobe analyses.

² UV-Vis spectroscopy/Micro-XRD.

³ Xanes and EXAFS analyses.

Table No. (4) shows, through chemical and radiological analysis, comparisons between the metallic luster of Iraq, Fatimid, Syrian and Iranian in terms of the name, the clay used, the percentage of lead oxide in paint, color, luster, and the proportion of copper and silver oxide and the presence of their ions (4)

From the analytical study of the previous table No. (14), whose results were from conducting a study on the products of historical metallic luster in these different eras through micro-Scooby analysis, spectroscopy, ultraviolet, and micro-XRD and EXAFS analysis showed that:

- The Iraqi metallic luster in the ninth and tenth century AD, the Fatimid luster in the eleventh and twelfth century, the Iranian and Syrian luster simultaneously at the end of the twelfth and thirteenth centuries and the Spanish luster from the fourteenth century until the fifteenth century and after that, which indicates the sequence and indicates that the development of the technology of metallic luster in this country came to benefit from its predecessor.
- The Abbasid, Fatimid, and Iranian metallic luster used a lead tin glaze and increased the percentage of lead oxide during the Abbasid luster itself and increased in the Fatimid and Iranian luster, because they realized the importance of lead oxide in relation to the luster of metallic luster, while the Syrian luster did not use a lead tin glaze but used a white clay paste and applied to it transparent alkali glaze and therefore their metallic luster was not shiny and the reason was attributed to the political turmoil that existed at the time. They were satisfied with the local materials only, or their lack of knowledge of the factors that make the metallic luster shiny, it is uncertain until now.
- The Abbasid luster is multicolored, in which copper was used with a ratio of 40 to 90%, the Fatimid metallic luster of one color depended on silver with a high percentage and the copper

percentage in it from 10 to 30%, while the Syrian luster relied on copper by 100% in Tel Minis and in Raqqa with 70% and the Iranian luster depended on copper with a ratio of 40 to 60%.

- The red color did not appear except in the Syrian luster, but it was a non-metallic and shine red color (13). This result could be the use of copper in a large percentage with strong reduction conditions, but metallic red did not appear as a result of not using tin lead glaze and used transparent alkali glazes lead free, The bright red metallic luster appeared in the Spanish metallic luster (Figure 11) for using copper with strong reducing conditions (their furnaces were specifically designed to create a strong reduction, so they built their kilns with two chimneys inside each other with double walls to increase the provisions of the kiln during the reduction) and the metallic red luster appeared in Iran also on the edges of the wares and dishes, and it could be because the edges can be heavily reduced from the rest of the ware, and the reason for the metallic luster mainly was their using lead tin glazes with other factors.
- The Syrian metallic luster used only ceramic paste such as the Egyptian paste with a white color after the fire. As for the Abbasid, Fatimid and Spanish luster, they used light clay rich in lime, Fatimid metallic luster initially used limestone clay in the eleventh century and in the twelfth century they used limestone clay with the Egyptian paste and also coarse clay. Therefore, we note that in all periods of metallic luster, they used white or light clay with it because of its importance in the appearance of bright metallic luster colors.

5. Research results:

- The use of lead- tin glazes with metallic luster is one of the main factors in the appearance of metallic luster.
- The use of lead-free glazes with metallic luster produces thick layers of matte metallic luster; unlike lead glaze, it produces a bright, shiny thin glossy layer of metallic luster.
- Adding copper to silver in a small percentage helps to turn silver into a metal image to give a silver metallic luster.
- The presence of Sn^{2+} tin, Fe^{2+} , copper Cu^+ , and Cu^{2+} adjusts the properties of the glaze and helps the formation of nanoparticles and the growth of their crystals, especially tin and copper, Fe^{2+} iron ions help to reduce copper to its mineral form Cu^{2+} to Cu^+ .
- Reducing copper to a metallic red is difficult and requires very strong reduction conditions and a long time in reduction, unlike silver, it is easy to reduce in normal conditions and short reduction time.
- The use of light clays with metallic luster shows the colors of metallic luster well.

6. Recommendations:

- Attention to studying the Islamic metallic luster because of its excellent technical and aesthetic results.
- Attention to reproducing pieces of Islamic metallic luster to revive this technique and deepen its study at the same time to reproduce the same degrees of historical Islamic luster and the same methods of production that were previously used for its aesthetic excellence.
- Providing educational and productive places for Islamic metallic luster with a high degree of mastery, to be exported to the world, so it will be a tourist and civilizational confrontation and it will compete with the products of China that have conquered the world.

- Collecting all the pieces of Islamic metallic luster and creating a museum of its own due to its importance, especially in historical Islamic ceramics.
- Attention to studying Fatimid and Spanish metallic luster, especially due to their distinguished aesthetic results in Islamic metallic luster

References:

1. Glòria Molina Giralt, Color and Technology in historic decorated glazes and glasses, Barcelona, February 2014 Thesis presented to obtain the Doctor's Degree from the Universitat Politècnica de Catalonia 1 Volume.
- 2 .Judit Molera and Mario Vendrell-Saz, Chemical and Textural Characterization of Tin Glazes in Islamic Ceramics from Eastern Spain, Journal of Archaeological Science (2001) 28, 331–340, , available online at <http://www.idealibrary.com>
3. Philippe Sciau, Nanoparticles in Ancient Materials: The Metallic Luster Decorations of Medieval Ceramics, All content following this page was uploaded by Ph. Sciau on 02 January 2014, CEMES-CNRS, University of Toulouse France, <https://www.researchgate.net/publication/230667907>
4. T. Pradell et al., Technology of Islamic luster / Journal of Cultural Heritage 9 (2008) e123ee128, Available online at www.sciencedirect.com
5. Trinitat Pradell et al., Technology of production of polychrome luster Article in Journal of the European Ceramic Society, September 2014 DOI: 10.1016/j.jeurceramsoc.2014.03.0, Available online at www.sciencedirect.com