

## TECHNOLOGICAL STUDY OF THE GILDED TILES OF IMAMZADAH ISMAIL TOMB IN QAZVIN, IRAN

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Gilding decorations on vitreous materials, such as the Islamic glassware from Egypt and Syria or gilded tiles found in Iran, Turkey and the central Asia have been previously studied either historically [1,2] or technologically [3,4]. In these studies, while the use of gold powder (or flake) has only been reported from glassware, the major emphasis has always been focused on the use of gold leafs on tiles [5]. For the first time, this paper uses portable X-ray fluorescence (pXRF) micro-analyses and micrographs of scanning electron microscope (SEM) were conducted to shed light on a less known technique of gilding on a *haft rang* tile from nineteenth century Iran found in Imamzadah Ismail of Qazvin.

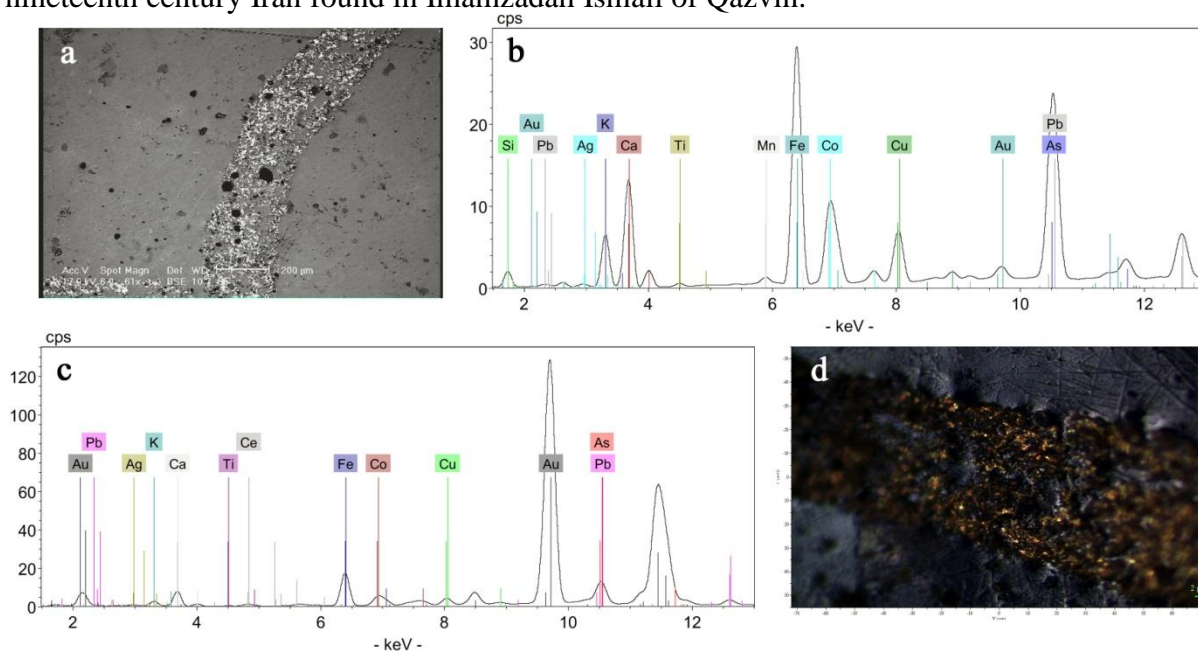


Fig. 1. (a) SEM micrograph of the gold flakes on the blue glaze together with (b) the pXRF spectra of the blue glaze and (c) the gold flakes, and (d) the optical microscope image of the gilded part on the blue glaze

The results showed that the blue glaze was basically an alkali glaze where Pb was incorporated to create probably a lead-alkali glaze to which Co was added as colouring agent (Fig. 1b). The presence of K in the composition of the blue glaze, moreover, showed that the plant ash has most certainly been used for supplying the alkali content of the glazes [6,7]. Moreover, the pXRF results showed an Iranian provenance for the blue glaze because the presence of As in the composition of the blue glaze could be associated with Co as the cobalt ore of Iran are mainly cobaltite ( $\text{CoAsS}$ ) and erythrite ( $\text{Co}_3(\text{AsO}_4)_2 \cdot 8(\text{H}_2\text{O})$ ) occurred in Kashan, central Iran [8,9].

On the other hand, the occurrence of Ag and Cu in the composition of the gold powder could be of interest. Despite the fact that the results of pXRF microanalysis were not quantitative (Fig. 1c), it could be deduced that the gold powder could not have been in a pure state and

that is most probably why the gold was used as powder instead of gold leaf. In other words, the lower malleability of the alloyed gold resulted mainly from Ag and Cu[10] was the reason of its use as gold flakes. However, one should consider that the detected Cu in the composition of the gold leaf can also be originated from the blue glaze underneath as Cu is either detected in the blue glaze. It is generally known that a tiny amount of copper was usually added to the archaeological glaze batches in Iran in order to achieve various shades of cobalt blue [11]. Furthermore, the SEM observations and a closer look under light microscope showed that the gold flakes were partially embedded in a pre-fired blue substrate glaze (Fig. 1a,d). As a result, the tile should have been re-fired after painting the gold flakes on the pre-fired blue glaze.

## References

- [1] Carboni, S., Henderson, J., 2003. *Mamluk enamelled and gilded glass in the Museum of Islamic Art, Qatar*. Islamic Art Society, London.
- [2] Porter, V., 1995. *Islamic Tiles*. British Museum Press, London.
- [3] Gueit, E., Darque-Ceretti, E., Aucouturier, M., 2010. Glass gilding process in medieval Syria and Egypt (13th–14th Century), *J. Archaeol. Sci.*, 37: 1742-1752.
- [4] Koss, K., McCarthy, B., Chase, E.S., Smith, D., 2009. Analysis of Persian Painted Minai Ware. In: *Scientific Research on historic Asian Ceramics: Proceedings of the fourth Forbes Symposium at the Freer Gallery of Art*, eds. McCarthy, B., Chase, E.S., Cort, L.A., Douglas, J.G., Jett, P., Archetype, London, 33-47.
- [5] Pacheco, C., Chapoulie, R., Dooryhee, E., Goudeau, Ph., 2007. Gold leaf decoration on medieval Islamic glazed ceramics – in search of technological features with XRD, *Z. Kristallogr. Suppl.*, 26: 317-323.
- [6] Tite, M.S., Shortland, A., Maniatis, Y., Kavoussanaki, D., Harris, S.A., 2006. The composition of the soda-rich and mixed alkali plant ashes used in the production of glass, *J. Archaeol. Sci.*, 33: 1284-1292.
- [7] Rehren, Th., 2008. A review of factors affecting the composition of early Egyptian glasses and faience: alkali and alkali earth oxides. *J. Archaeol. Sci.*, 35: 1345-1354.
- [8] Allan, J.W., 1973. Abu'l Qasim's treatise on ceramics, *Iran*, 11: 111-120.
- [9] Stöllner, Th., 2004. Notes on mining archaeological structures at the cobalt mine of Qamsar, in: *Persiens Antike Pracht*, eds. Stöllner, Th., Slotta, R., Vatandoust, A., DBM, Buchum, 515-517.
- [10] Nutting, J., Nuttall, J.L., 1977. The malleability of gold: an explanation of its unique mode of deformation, *Gold Bulletin*, 10: 2-8.
- [11] Holakooei, P., Tisato, F., Vaccaro, C., Petrucci, F.C., 2014. Haft rang or cuerda seca? Spectroscopic approaches to the study of overglaze polychrome tiles from seventeenth century Persia, *J. Archaeol. Sci.*, 41: 447-460.