Characterization of gold leaves on Hellenistic terracotta artifacts: a PIXE-RBS mapping study

Fourdrin C.[(1)], Pagès-Camagna S.[(1)], Pacheco C.[(1)], Radepont M. [(1)], Lemasson Q.[(1)], Moignard B.[(1)], Pichon L.[(1)], Bourgeois B.[(1)], and Jeammet V.[(2)]

(1) Centre de Recherche et de Restauration des Musées de France, 14 quai François Mitterrand 75001 Paris

(2) Musée du Louvre, Département des Antiquités Grecques, Etrusques et Romaines, Pavillon Mollien, 75001 Paris

In this research supported by the Patrima Foundation, we present new insights on the composition, thickness and application of the gold leaves present as decorations on several terracotta artifacts excavated around the Mediterranean basin (Greece, Turkey, Egypt and Italia). The studied corpus is composed of 28 objects dating from the IVth century B.C. to the Ist century A.D. They are funerary figurines, representing women such as the draped figure known as "Lady in Blue", an exceptional piece from Tanagra, or decorations pieces for the deceased (small flowers, buttons or pearls), kept in the Louvre Museum. In a previous work [1], the thicknesses of the leaves were estimated by X-ray fluorescence spectroscopy to be less than 1 μm. However, a precise determination was not achieved since the detection limit was reached.

In the present study, the thicknesses of the gold leaves were determined using RBS spectroscopy with 3 MeV H^+ or α particles. The RBS-PIXE experiments were conducted at the AGLAE facility (C2RMF, Paris). Without sampling, the acquired maps permit to differentiate the layers present below the metallic leaf. On those artifacts, the usually observed stratigraphy is composed of the following layers (Figure 1): the terracotta support (1), a white preparation layer (2) and most of the time a ferric bolus (3). The gold purity was calculated using H^+-PIXE assuming a constant copper concentration in the preparation layer.

The thicknesses were calculated using SIMNRA software. For all studied artifacts, the obtained values are below 1 μm, therefore corroborating the previous results. The calculated thicknesses ranged between 250 and 600 nm for a gold purity mostly superior to 95%, strongly suggesting an ancient purification process as well as a developed goldbeating technique during the Hellenistic period around the Mediterranean Sea. We will also discuss the values and errors bars obtained by H^+ and α particles.

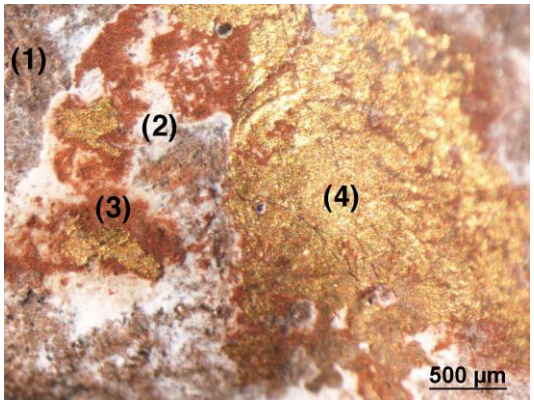

Figure 1: (1) terracotta support, (2) preparation layer, (3) bolus, (4) gold leaf

[1] B. Bourgeois, V. Jeammet, S. Pagès-Camagna. Bulletin de Correspondance Hellénique, 136-137, p. 483-510, 2014