EDXRF AND XRD FOR THE STUDY OF LASER CLEANING OF CARLINO COIN

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Silver artefacts and particularly ancient silver artefacts present along the time the serious problem of the tarnished surfaces due to the ambient pollution. The black colour is, in fact, the consequence of the layer containing compounds based on sulphur, i.e. acanthite (Ag_2S) and jalpaite (Ag_3CuS_2). Recently, laser cleaning technique has demonstrated to be very promising in the artworks conservation because it can remove the surface contaminations precisely and selectively.

In this paper, we shall present the potentiality of the laser cleaning technique on the reduction of the sulfur concentration from the surface artefacts. In order to operate the laser cleaning in safety way to remove only the contamination layers, we determined first the laser fluence threshold of the bulk, second we control the surface compounds and at the end we operated the laser irradiation.

In order to estimate the laser threshold values, we utilized certified silver and silver/copper samples. The laser beam was provided by a KrF laser operating at 248 nm, 20 ns pulse duration focused by a 50 cm focal length lens. Profilometry measurements of the crater profiles obtained at different laser fluences were utilized to determine the laser fluence thresholds of the samples which resulted to be 780 and 510 mJ/cm^2 for the Ag pure and for the Ag/Cu alloy, respectively.

On the consequence of these studies, we applied the laser cleaning technique on a Carlino coin made of silver/copper alloy coined in 1689 under King Carlo II. In order to evaluate the inventory of the elements and the silver compounds during different steps of the laser cleaning, a portable apparatus for Energy Dispersive X-Ray Fluorescence (EDXRF) spectrometry and a X-ray diffractometer were used. The characteristics of the EDXRF and XRD instrumentation are described in the references [1,2].

XRD analysis confirmed the presence of jalpaite on the coin surface (Figure 1). EDXRF analysis were performed on four different areas (Figure 2) of the coin in order to asses the presence of the sulphur before the laser treatment and during the laser cleaning at different laser doses. Figure 3 shows the sulphur concentration vs laser doses for the different treated areas. Figure 4 shows the laser cleaning action on the removing of the tarnished layer due to the contaminations. Experimental results about the laser cleaning of Ag/Cu ancient coin show that the UV pulsed irradiation can be used safety as a powerful tool to remove the sulphur patina from the coin surface. Working below the laser fluence threshold, indeed, the UV laser action is able to reduce the sulphur concentration more than 80%.

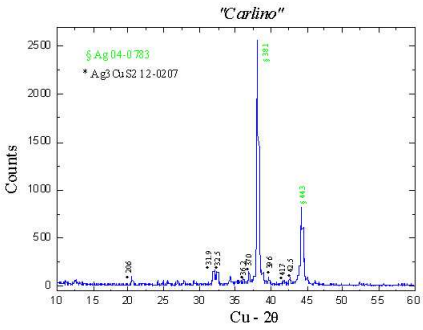

Figure 1. XRD on *Carlino* coin.

Figure 2. Areas of *Carlino* coin on which was performed EDXRF analysis.

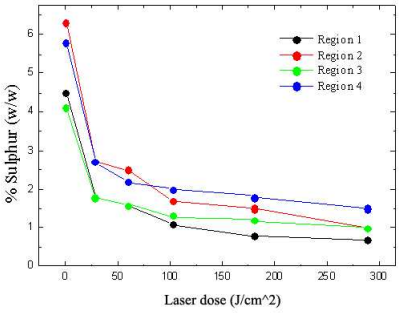

Figure 3. Sulphur concentration on *Carlino* coin vs laser dose.

Figure 4. *Carlino* during laser cleaning.

REFERENCES

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