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St. Petersburg, Russia, June 25–29, 2012

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ОПТИКА ЛАЗЕРОВ
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LASER CLEANING OF METAL THREADS IN HISTORIC TEXTILE

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Metal laser cleaning is one difficult problem to tackle at Heritage as they are very delicate surfaces at high temperature. Nevertheless, the cleaning of corrosion or dirtiness layers is possible without damage or fusion of the alloy at optimized parameters. On the other hand, textile artworks laser cleaning has been carried out successfully, but a special care must be taken in mechanical resistance properties and color changes. This paper has focused on special case in restoration, the removal of corrosion of metal thread in historic textiles with fine golden needlework.

The present study is based on the evaluation of laser cleaning conditions for removing different corrosion and dirtiness on golden needle inside clothes. The aim of this work is to optimize the laser cleaning conditions of metal needle used in restoration, and a guideline for good restoration practices. For this reason, golden needle has been characterized before and after laser tests by a X-Ray diffractometer Bruker D-8 Advanced XRD, a FT-IR Spectroscope Perkin Elmer Spectrum One with Universal Attenuated Total Reflectance (UATR) accessory, a Optical Microscope Leica DM4000M and a EDX-SEM Microscope JEOL JSM-6460 LV with INCA X-sight software.

A Q-swithched Nd:YAG laser, ART LIGHT II; at 1064 nm, 8 ns and different fluencies and frequencies was used for laser trials. The laser cleaning tests were carried out according to restorer's observations. The distance between laser handle and specimens was about 7.6 cm, the beam of diffuse light was of 2 mm of diameter. The laser was applied both to dry surfaces and to wet surfaces with mixture of ethyl alcohol/water. The laser ablation threshold has been calculated as the necessary fluency to produce changes on surfaces perceptible by the restorer tools. Special attention was given to surface damage and color changes on clothes and needles. Colour variations were measured using a colorimeter and surface morphological changes were observed under optical microscope and EDX-SEM.

The textile piece of 10.28 x 7cm belongs to the "Virgen de los Dolores de la Venerable de la Orden Tercera Servitas de Málaga". It is a mantle that is called of "dressing room", because it is not used during Holy Week, and it is for internal worship in the Temple.
The mantle was made in the Esperanza Elena Caro`s workshop in Seville at the beginning of the Spanish Civil War, 1936. It is made of colored silk velvet embroidered in golden metallic thread called "Spanish point". Its design follows the romantic styles of mid-nineteenth century. Our research is based on the cleanup and restoration of metallic lace of the perimeter textile piece.

The corrosion of the golden needle pieces (figure 1) are different cooper products of blue-green color.

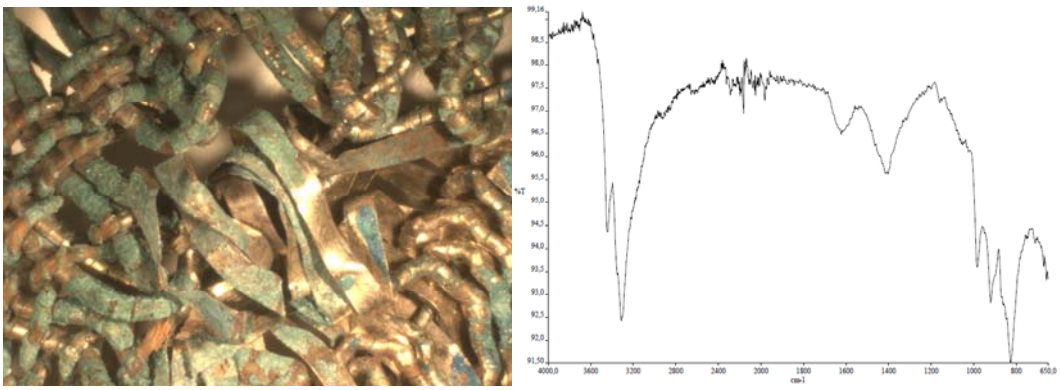

Figure 1. a) Copper corrosion products over golden needle, b) IR spectrum of corrosion copper products.

The physicochemical methods used to evaluate the effectiveness of the laser cleaning shows very promising results, without any discoloration or disruptive effects of the silk velvet and the golden needles for the following conditions: laser Nd: YAG at 1064 nm, 8 ns, 20 Hz y 50 mJ, the needle were watering with a mixture of water/ethanol 1:1, and it was necessary to locate the artwork at 45º and use a air pump system to avoid the corrosion product to fall down on silk velvet