SPECTROSCOPIC STUDIES OF CULTURAL HERITAGE OBJECTS IN REPUBLIC OF MACEDONIA

Orhideja Grupče and Biljana Minčeva-Šukarova

Institut za hemija, PMF, Univerzitet "Sv. Kiril i Metodij", PO Box 162, 1001 Skopje, Republic of Macedonia
orhideja@iunona.pmf.ukim.edu.mk

In order to improve the preservation and conservation of cultural heritage in Republic of Macedonia and increase the knowledge and understanding of museum objects through non-destructive analysis and testing, activities regarding the use of μ-Raman spectroscopy in characterization of archaelogical and museum object are undertaken. Additionaly, infrared spectroscopy and X-ray fluorescence were used.

Raman spectroscopy, in the last decade, is gaining popularity as non-destructive analytical tool providing informations on molecular compounds e.i. identification of materials and surfice modifications, in studies concerning cultural heritage. We have focused our interest on pigment analysis in medevial paintings (icons and frescoes) and Byzantine glazed ceramics analysis.

As part of a pigment analysis, using Raman spectroscopy, five pigments were analyzed (blue, red, orange, pink and yellow) from six icons painted by well known Macedonian painter, Dicho Zograph, in three different churches in the Skopje region. Comparison was made between the pigments used for paining the icons in 1845/46 with those painted in the year1853.

In order to achieve some understanding and characterization of the materials and provenance of the Byzantine glazed ceramic finds in Republic of Macedonia, as well as to achieve technological information on the manufacturing of the objects, fifteen fragments, all dated from 12^{th} to 15^{th} century, were analysed. All samples have an underglaze engobe and are characterized with sgraffito slip decoration. They are glazed in brown, black, dark green or ochre colour, some of them have specks. Characteristic Raman bands of ceramics are identified and their relationships with the fluxing PbO are discussed. The procedure to identify different families of glassy silicate artefacts is based on the peak area ratio (A_{500}/A_{1000}) related to symmetric Si-O-Si bending (~500 cm^{-1}) and Si-O stretching (~1000 cm^{-1}) modes. Based on the results from the Raman spectra, it was possible to enlighten firing temperature of the glaze. The mineralogical composition of the ceramic glazes and the characteristic underglaze engobes were analysed by X-ray fluorescence spectroscopy. Infrared spectroscopy was used in characterization of the ceramic body.

Attention is paid to the identification of salts in efflorescence in the churches in Republic of Macedonia. This effect causes damage and deterioration of objects and is serious treat to the frescos and wall paintings in churches. Conservation treatments of these objects are highly dependent on well-established knowledge of the present salts in the efflorescence. On the other hand, identified salts could indicate the degree of degradation processes as well as the origin of the efflorescence. An attempt is made, using target factor analysis (TFA), to develop simple and practical approach to the problem of identification of the salts, convenient for use in everyday conservators work. The development of the TFA model requires creation of infrared spectra database of substances often found in the efflorescence. The database was created using infrared spectra of 18 salts, binary and tertiary mixtures. The TFA procedure consists of two stages: (1) determining the number of components in the mixtures and (2) comparison of the obtained spectra with the ones, stored in the database.