Scientific Investigations of a 16th Century Stall Belonging to the Evangelic Church from Bistrita, Bistrita-Nasaud County, Romania

S.P. Grapini[1], A. Baciu[2], C. Marutoiu[2], M. Miclaus[3], V.C. Marutoiu[2], S. Dreve[3], I. Kacso[3] and I. Bratu[3]

[1] National History Museum of Transylvania, 2 C. Daicoviciu st, R-400020, Cluj-Napoca, Romania
[2] U.B.B., Faculty of Orthodox Theology, 18 Avram Iancu sq, R-400117, Cluj-Napoca, Romania
[3.] National Institute for R&D of Isotopic and Molecular Technologies, R-400293, Cluj-Napoca

Abstract

The Evangelic Church from Bistrita City is one of the important gothic monuments from Romania. Inside of the church there have been preserved a series of furniture pieces from different centuries, and the stall that has been analyzed in this study is one of them. The study presents the investigations that were made on the occasion of restoring the stall. The nature and the status of the wooden supports were investigated by several methods: Fourier transform infrared (FTIR) spectroscopy, X-ray diffraction (XRD) and differential scanning calorimetry (DSC) analysis together with the composition of the painting layer which covers the front side of the stall. The back side of the stall was spruce fir wood and its status was also investigated. The nature of the component elements and the heritage value of the ensemble were also established.

Introduction

The aim of this paper was to identify the materials (wood and pigments) used in the ancient Evangelic wooden stall. Because pigments based on copper carbonates excludes some of procedures usually applied on painted surfaces, it became important to identify the nature of the green pigment present in the painting covering the front side of the stall, in our case probably malachite.

Materials & Methods

The wooden samples were investigated with FTIR (JASCO 6100 using KBr pellet technique) and fluorescence (FP 6500 spectrofluorimeter) spectroscopy, DSC (DSC-60 Shimadzu calorimeter) and X-ray diffraction (Bruker D8 AVANCE) techniques. The pigment samples were analyzed by FTIR spectroscopy.

Results

Two types of wood - lime (front side of the stall) and spruce fir (back side of the stall) - were sampled, cleaned, grinded and analysed.

FTIR investigation and comparison between old and new wood samples is presented in Fig. 1.

For the identification of the green pigment it was produced in laboratory green colour sample mixing malachite and animal glue binder. The resulting spectra are presented in Fig. 2.

It was established that the crystallinity degree is higher for a historical spruce fir wood as compared to the actual one (Fig. 3). Also, the diffraction peak of the historical wood is shifted towards higher angles values that mean the lattice constants are lower as compared to the actual spruce fir wood's values. The historical spruce fir wood is more compact that the actual one.

The spruce fire wood sample presents two exothermic signals in DSC (Fig. 4), around 345 and 473°C, assigned to cellulose, respectively to native lignin [1]. The spruce fir stall wood sample shows a decreased and shifted lignin peak around 426°C and another strong exothermic peak at 463°C probably due to the presence of oxalates, as a result of the wood-boring beetle and fungal attack.

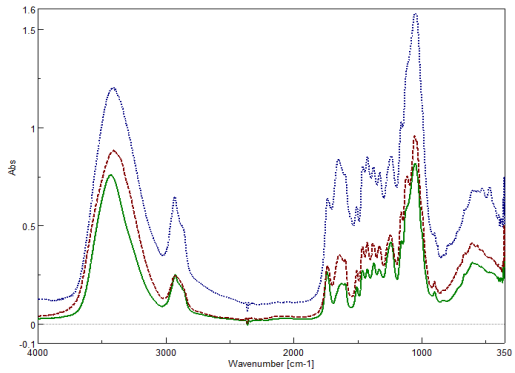

Fig.1, FTIR spectra of the lime wood samples: Green line: spectra of new lime wood; Blue line: spectra of old lime wood from exterior surface of the stall; Red line: spectra of old lime wood from the inner part of the stall

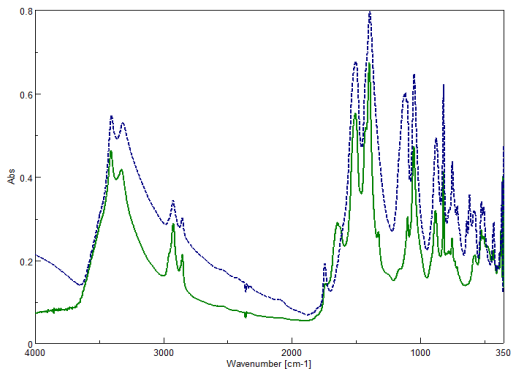

Fig. 2, FTIR spectra of green pigment sample: Green line: spectra of original green pigment, sample from the front side of the stall; Blue line: spectra of standard green colour (malachite and animal glue binder)

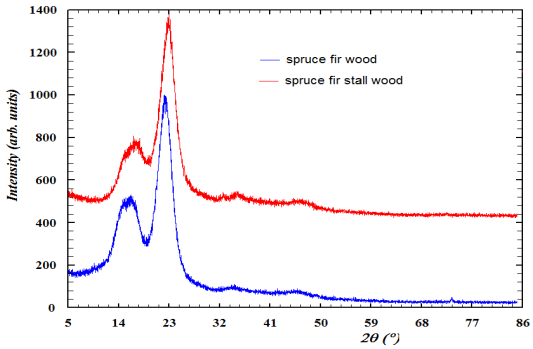

Fig. 3, XRD patterns of the spruce fir wood samples

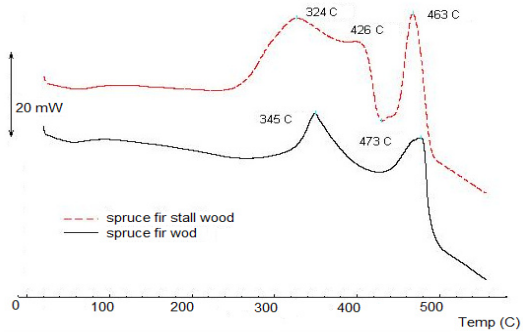

Fig. 4, DSC curves for spruce fir wood samples

Cellulose express its fluorescence in the characteristic region 440-468 nm for both old and new spruce fir wood and, respectively, lime samples while lignin express a much lower fluorescence for an excitation of 375 nm (Fig.5). The phenomenon is generated by the equally graduated degradation of wooden cellulose independently of the nature of the wood, fluorescence increasing with the period of degradation and being specifically expressed for each kind of tested wood samples [2].

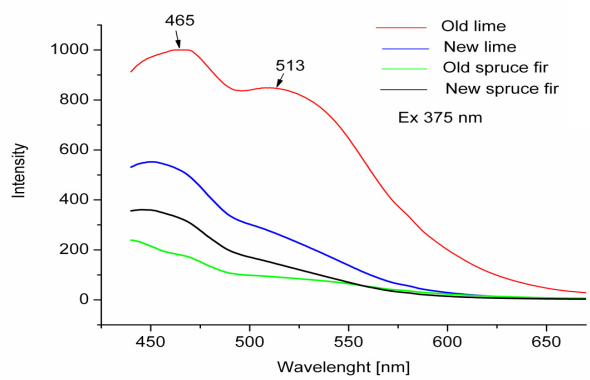

Fig. 5, Fluorescence spectra of wood samples

Conclusions

The employed techniques demonstrated the nature and the preservation state of the materials used for the stall from Evangelic Church Bistrita. Fluorescence parameters depending of specificity and age of wooden samples can contribute to a database for identification of artefacts.

References

1) U. Reh, G. Kraepelin, I. Lamprecht, Use of differential scanning calorimetry for structural analysis of fungally degraded wood, *App. Environ. Microbiol.*, 52(5) (1986) 1101-1106.

2) C. Clementi, C. Miliani, A. Romani, U. Santamaria, F. Morresi, K. Mlynarska, G. Favaro, In situ fluorimetry: A powerful non-invasive diagnostic technique for natural dyes used in artefacts, *Spectrochimica Acta Part A*, 64 (2006) 906-912