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Nanomaterials for Chemical and Biological Restoration of Old Books

Abstract

For many centuries, paper has been the main material for recording cultural achievements all over the world. Art restoration is a partnership between art and chemistry, chemical analysis acting to minimize risks when restoring a work of art. Today, modern chemicals, such as nanocompounds, are essential for the preservation of the world's artistic and cultural heritage. Tasks belonging to nanoparticle chemistry (type of nanoparticles, structure, analysis), especially for the conservation and restoration of paper documents and old books, are discussed in this paper.

A new method of old book restoration, based on a special suspension of hydroxyapatite nanoparticles, is presented and discussed in this paper. This new method is based on the properties that allow nanoparticles to penetrate into the network of cellulose fibres and adhere to them, covering the damaged area and consolidating the paper, without covering the ink. Several methods of instrumental chemical analysis have been employed: Infrared spectroscopy Fourier-transformed (FTIR), Scanning Electron Microscopy (SEM), atomic force microscopy (AFM), thermal analysis, dynamic light scattering (DLS), X-ray diffraction (XRD), energy-dispersive X-ray fluorescence (EDXRF) and induced coupled plasma-atomic emission spectroscopy (ICP-AES) have been used in order to complete the composition of the Romanian Gospel from 1740 (from private collections) and to establish the best method for restoration it.

Special attention was paid to the positive effects of hydroxyapatite nanoparticles, not only in the chemical and physical restoration of cellulose, but also for its special property in microbiological decontamination. Historical paper in environmental conditions is an ideal medium for fungi growth, most frequently *Penicillium* and *Aspergillus*. This paper

is also focused on fungal decontaminating treatment using hydroxyapatite nanoparticles applied to the paper.