

Post-irradiation effects on the properties of paper

Constantin Daniel Negut, Ion Bogdan Lungu and Silvana Vasilca

Gamma radiation can be used for disinfestation of cultural heritage artefacts that contain materials which are a source of food for the species involved in biodegradation. A dose of 10 kGy can be regarded as a threshold below which functional properties of artefacts are not significantly affected.

One of the issues is the stability of free radicals induced by irradiation and their post-irradiation effect on the properties of sensitive materials such as paper. Previous studies used thermal annealing of radiation induced free radicals because their depletion can take months. This method can overestimate their effect because at room temperature most of them combine locally, thus producing no post-irradiation effects.

In this talk, we present the room temperature kinetic of radiation induced free radicals on different types of paper and their effect on the colour and mechanical properties. Post-irradiation effects on 10 kGy gamma irradiated fresh and naturally aged paper were evaluated over 4 years. Mechanical tests show no significant post-irradiation effects except for office paper that exhibits a decrease in force at break (in the cross-machine direction) of about 20 % when measured two years after irradiation. For all the samples, the colour changes over time for both non-irradiated and irradiated samples follow the same direction and small, measurable differences will be insignificant in the long term. In conclusion, irradiation of naturally aged paper at an upper dose of 10 kGy will not produce any significant post-irradiation effect.

Biography

Constantin Daniel Negut received his PhD in Physics from the University of Bucharest, Bucharest, Romania, in 2011, with a thesis on Electron Paramagnetic Resonance spectroscopy study of gamma radiation induced defects in solids. In 2003, he joined IRASM Radiation Processing Department of HORIA HULUBEI National Institute of Physics and Nuclear Engineering, Magurele, Romania. His main area of research is related to the various applications of gamma irradiation effects on materials, such as dosimetry, material properties enhancement, detection of irradiated food, or disinfection of artefacts. He was involved in many national and international research projects related to the use of ionizing radiation for the investigation and preservation of artefacts, such as COST Action IE0601 "Wood Science for Conservation of Cultural Heritage" or IAEA CRP F23032 "Developing Radiation Treatment Methodologies and New Resin Formulations for Consolidation And Preservation of Archived Materials and Cultural Heritage Artefacts." His research activity has been focused on the effect of irradiation on the functional and decorative properties of the artefacts and the postirradiation effects of radiation

induced free radicals in sensitive materials such as paper. In a series of experiments, he showed that at absorbed doses (lower than 10 kGy) used for the treatment of bio-deteriorated paintings, colour changes induced by gamma irradiation are insignificant for historical pigments and binders.