

Application of Broadband Dielectric Spectroscopy to Cultural Heritage: characterization and preservation of ancient paper artwork

Margarita Fomina and Antonio Cupane

Department of Physics and Chemistry, University of Palermo, Viale delle Scienze Ed.18,
90128-Palermo, ITALY

In this work we use broadband dielectric spectroscopy (BDS) to investigate the relaxation behaviour of water dipoles within the cellulose matrix of ancient paper artwork. Paper samples were taken from the unprinted guard sheets of ancient books –with printing date from XVI to XX century- from a private library (Fig.1, left panel). The BDS spectrum exhibits a well resolved peak that can be attributed to water molecules inside the cellulose matrix pores and that shifts to higher frequencies in ancient paper (Fig. 1, right panel), likely due to the increased pore size due to cellulose degradation following hydrolysis and/or oxidation. The relaxation times were shown to depend upon the book printing date and the age dependence suggested that the main degradation occurs within the first 100 years age of the book. Most interestingly, paper treatment with Halloysite nanotubes (HNT) restored the relaxation time characteristic of modern undegraded paper, suggesting that treatment with nanofillers may be effective in paper preservation.

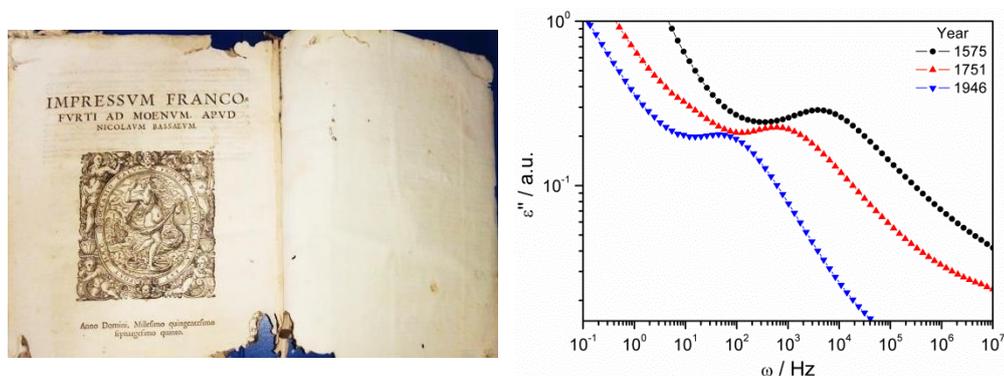


Figure 1. Left panel: XVI book printed in Frankfurt, 1575. Right panel: Dielectric spectroscopy data on historical paper of different years.