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Pyrolysis-compound specific isotope analysis (Py-CSIA) of polymers and biopolymers: possible applications in heritage conservation.

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Given the artistic, social and economic value of cultural heritage, its conservation is of upmost importance for being preserved for future generations. Through accurate characterization of organic materials, such as alteration products and biopolymers used in the past as construction, supporting or protective materials of in monuments and artistic artifacts, it would be possible to ameliorate the conservation practices for controlling deterioration.
Pyrolysis-compound specific isotope analysis (Py-CSIA) is a novel analytical technique able to provide, not only an accurate identification of organic compounds in different complex matrices, but also additional valuable information about nature and origin of the materials based on their isotopic composition. This technique is based on the coupling of a micro-furnace pyrolyser (F.Lab 3030i) to a gas chromatograph (GC) and using an isotope ratio mass spectrometer (IRMS) as detector. The individual volatile pyrolysis products separated by gas chromatography are directed to a combustion or a pyrolysis micro-reactor (GC-Isolink system) and finally the isotope composition of the gases produced measured in the IRMS (Thermo Fisher Delta V Advantage) via an appropriate interface (ConFlo IV universal interface unit). With this technique it is possible to make direct measures of stable isotope ratios (i.e. [U+1D6FF]13C, [U+1D6FF]D, , [U+1D6FF]15N and also [U+1D6FF]18O) of specific compounds with minimum sample handling.
In this communication we will introduce the Py-CSIA technique in the field of cultural heritage as a novel technique for the direct determination of the isotopic composition of polymers and biopolymers. Case studies on the characterization of biopolymers using Py-CSIA will be presented and the potential application in the field of cultural heritage conservation discussed.