Development of a Toolbox for studying the Chemistry of light-induced degradation

Iris Groeneveld[1], Mimi den Uijl[2], Govert Somsen[1], Freek Ariese[1], Peter Schoenmakers[2], Maarten van Bommel[2,3]

[1]*Bioanalytical Chemistry, Vrije Universiteit Amsterdam, The Netherlands, i.groeneveld@vu.nl;* [2]*Faculty of Science, University of Amsterdam, The Netherlands;* [3]*Faculty of Humanities, University of Amsterdam, The Netherlands*

Many organic compounds change under the influence of (UV) light. Sometimes this is beneficial, for example in water purification, but in many other cases this is undesirable, for example when cultural-heritage objects fade, affecting their esthetical value, or when healthy food ingredients (e.g. vitamins) degrade or when undesirable flavours are formed. Studying photochemical conversion is challenging and can be very time consuming. Often it is difficult to establish a strong link between the degradation products and the starting materials which results in poor degradation-prediction models.

An innovative, high-resolution and fully orthogonal system is developed to study degradation of a wide range of mixture components under the influence of light. Complex mixtures can be separated on a (first) High Performance Liquid Chromatography (HPLC) system after which components can selectively be trapped, either separately or simultaneously in a photo-degradation cell. For this cell we will make use of a Liquid Core Waveguide (LCW) which is typically a small inner diameter tubing made of Teflon. As the refractive index of this type of Teflon is lower than that of the liquid core, i.e. water or organic solvent, the excitation light undergoes total internal reflection and will be guided along the length of the cell. The trapped analytes can then continuously be illuminated by means of lasers or LED's at any desired wavelength(range). Scattered light from the sample is collected at the end of the exposure cell and its intensity can be monitored, but can also be converted into absorption and/or Raman spectra. By looking at the changes in the absorption and Raman spectra, it will be possible to observe which chemical changes take place over time. When the photo-degradation is satisfactory, a second separation of the degradation products will take place, followed by detection using Mass Spectrometry.

After having created this 'Toolbox for Studying the Chemistry Of Light-induced Degradation' (TooCOLD), it will be applied on samples from cultural heritage, food and food packaging materials, and on drinking water. We expect to shorten the time needed for degradation studies up to 40 times using this approach.