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Characterization of biomass and biochar by LDI-FTICRMS

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Pyrolysis of lignocellulosic biomass is one the main pathway for a renewable and sustainable production of energy such as biofuels. Many studies have focused on the characterization of the produced compounds to understand the pyrolysis mechanism. However, it is also of significant importance to exhaustively characterize the raw material and the produced biochar. Due to its sensitivity and its ability to investigate without preparation bulk complex systems, the laser desorption/ionization associated with FTICRMS is a very powerful tool. To the best of our knowledge, this technique is developed for the first time to reveal the chemistry of biomass and biochar, as well as to “map” the composition of particles.

The experiments were conducted on different biomasses (douglas, oak, miscanthus) and on biochars Mass spectra were acquired on a 9.4 T-FTICR mass spectrometer coupled with different lasers. The investigated samples (wood and biochar) were introduced into the ionization chamber without further preparation step Mass spectra were post-processed and Van Krevelen diagrams, compound class distributions and DBE vs. C atom number diagrams were plotted. These diagrams were used to ensure an easy comparison of the different samples.

Depending on the used experimental conditions (e.g. laser wavelength and laser fluence) different kinds of information were obtained whatever the investigated sample (raw wood and biochar). Strong differences in mass distributions were observed for the same sample under different laser ionization sources. In some cases, the resulting mass spectrum was highly connected to the sample components and in others, it corresponded to the superposition of different information: (i) the chemical components of the investigated samples, (ii) the recombination products of these species in the gas phase after their ejection from the sample surface and (iii) the compounds produced by laser pyrolysis of the sample. The results were significantly complicated but still important and relevant information on the pyrolysis event were still possible to estimate. The comparison of the results obtained for a given raw wood and its biochar produced by “classical pyrolysis” has enabled identifying parts of the compounds produced by laser pyrolysis. Such experiment may consequently to be considered to model “classic pyrolysis” phenomenon. In addition, the comparison of the results obtained for biomasses were useful to investigate the dependency of the physical and chemical properties of wood on the pyrolysis products.

Use of laser/desorption ionization to investigate biomass, biochar and pyrolysis biomass mechanisms in the field of biofuel production.