CHARACTERIZATION OF BIOCHARS BY NUCLEAR MAGNETIC RESONANCE

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Biochar is grabbing interest due to multifunctional roles in soil, pollution mitigation and carbon sequestration[1]. However, chemical mechanisms of biochar formation during pyrolysis are still poorly understood. Moreover, the biochar chemical composition and physical structure should be tailored for their different applications [2]. Nuclear Magnetic Resonance (NMR) played a crucial role into biomass and carboneous solids structure elucidation[3]. Indeed, for decades, NMR solid state methods have been developed to study carbon-based materials.

In this talk, we will review the last 15 years of research performed by our groups on biochar characterization by various NMR methods. Several NMR techniques have been developed and combined to study biochars from different feedstocks (wood, herbaceous plant) at different temperatures (200-800°C). Indeed, high resolution 2D solid ^{1}H-^{13}C NMR, quantitative 1D ^{13}C NMR [4], [5], ultra-fast 1D ^{1}H NMR methods have been developed in order to study biochars chemical structures. The conversion of main moieties present in biomass and the formation of aromatic clusters present in biochars have been quantified by a specific quantitative ^{13}C CP/MAS NMR method[5]. In situ ^{1}H NMR analysis have been used to understand the mechanism of biochar formation through an intermediate "visco-elastic" material during pyrolysis process[6] (including minerals catalytic effects). Moreover, ^{1}H NMR relaxometry analysis shows that heating rate and temperature play a significant role on the surface affinity between biochar and water.
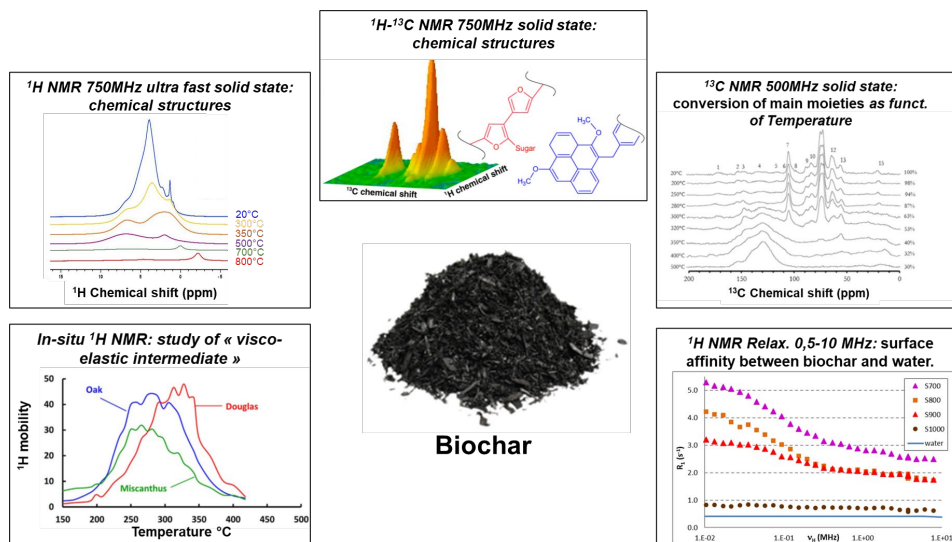

Figure 2: Some NMR methods developed for biochar characterization

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