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NMR Study of water transfer from bio-based materials to the living plant

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In the context of climate change, studies of water transfer in bio-sourced materials are becoming essential in order to meet the multiple challenges of developing high-performance materials over the long term and preserving resources while limiting greenhouse gas emissions. One of the keys to supporting these studies is access to the "water status" in these porous materials [1]. However, the monitoring of their performance over time is often limited to destructive studies or relies on techniques that are too local or average, or even intrusive.

Here, we present the development of an innovative methodology based on nuclear magnetic resonance (NMR) relaxometry and imaging (MRI) at low and high magnetic fields, respectively, to study water content and transport during water stress in living materials, from the leaf to the whole plant scale. The results obtained by the combination of these approaches will be compared with water transfers in model porous materials such as wood, cellulose, glass beads, etc. Indeed, thanks to NMR approach, it has been possible to identify the drying mechanisms in wood and to show that bound water plays a fundamental role, transporting, by diffusion, free water from the interior of the material to the free surface, and this during all the drying phase [2]. Another interesting result concerns the behavior of NMR signal and relaxation times in two contrasted genotypes in term of cellulosic ratio. This dependence of relaxometry provided an important information on molecular dynamics directly related to plant resistance [3].

This study has demonstrated the potential and the versatility of NMR relaxation as a means to characterize the microstructure of living porous material and model water transport mechanisms under different environmental constraints.

Participation

In-Person

References

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