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Cellular nano-architecture unveiled by tomo-ptychography: perspectives on X-ray coherent imaging to plant biology and agricultural sciences

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Knowledge of the nano-architecture of plant structures gives insights into basic physiological processes and is also useful for biotechnological purposes such as biomass deconstruction for industrial processing. High-resolution imaging techniques such as electron-based microscopies are crucial to access cellular ultrastructure. However, more precise quantification of structure at such level of detail is only possible with 3-dimensional imaging. In this presentation, we will demonstrate how X-ray tomo-ptychography unveils structural features, at 3D nanometric spatial scales, which can be correlated with plant phenotype. For example, such experiments were used to access cell wall morphology and quantify structures in specific cellular tissues of wild-type and transgenic/mutant grasses, as well as to investigate pollen grains under different conditions. We will discuss preparation conditions for plant specimens and 3D imaging that allows exploration of dissimilarities at cellular level between different plant genotypes and highly accurate quantification of intracellular structures. Finally, we will demonstrate how tomo-ptychography experiments carried out at the CATERETÊ beamline at the 4th-generation Sirius synchrotron in Brazil paves new ways to explore plants and other agricultural systems and provides a complementary tool for nanoscale structural studies.

Keywords: grasses, pollen, coherent X-ray scattering imaging

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