Using time-resolved scattering techniques to study nanoscale wood-water interactions

Nayomi Plaza[1], Sai Venkatesh Pingali[2], Joseph Jakes[3], Chris Hunt[4], Eugene Mamontov[5]

[1]Forest Service Forest Products Laboratory [2]Oak Ridge National Laboratory, [3]USDA Forest Products Laboratory, [4]USDA Forest Products Laboratory, [5]ORNL

nayomi.plazarodriguez@usda.gov

Understanding and controlling water in wood is critical to both improving forest products moisture durability and developing new sustainable forest products-based technologies. Due to the inherent complexity of wood structure and chemistry, our knowledge on the wood-water interactions needed for increased durability is still lacking. Research at macro levels has provided some insight, but an improved understanding of the wood-water interactions at the subcellular level (from 1 to 100 nm) has been missing. Advanced neutron scattering techniques are ideally suited to probe changes in wood nanostructure because they have increased contrast due to their isotope sensitivity and allow for in situ humidity control. Time-resolved scattering techniques offer a unique opportunity to provide new insights on this subject, yet they are still underutilized in forest products research. In this talk, I will provide a brief overview on the opportunities and challenges for using time-resolved scattering to study moisture-induced structural and dynamics changes in unmodified and chemically modified wood. SANS studies capable of measuring the moisture-induced swelling of wood nanostructure from 1 to 100nm will be discussed. Additionally, QENS studies meant to probe these interactions spatially from 0.3 to 3 nm and temporally in the range of 3 to 400 ps will also be highlighted. These findings are expected to inform the development of new protection treatments that can improve the decay resistance and overall durability of forest products used outdoors.