



Nano-Indentation Creep Properties of the S2 Cell Wall Lamina and Compound Corner Middle Lamella

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Abstract

Bulk wood properties are derived from an ensemble of processes taking place at the micron-scale, and at this level the properties differ dramatically in going from cell wall layers to the middle lamella. To better understand the properties of these micron-scaled regions of wood, we have developed a unique set of nano-indentation tools that allow us to measure local elastic modulus and hardness creep properties. The creep measurement entails a technique called broadband nano-indentation creep (BNC), which is able to probe the material flow behavior across four decades of strain rate. Because conventional nano-indentation techniques are poorly suited for testing highly heterogeneous specimens, such as wood cells, we have developed a method for removing artifacts caused by heterogeneities. After these artifacts are removed, the elastic modulus can be determined in the usual way. In loblolly pine, we measure the properties of the S2 cell wall lamina (SCWL) and the compound corner middle lamella (CCML) of both untreated and ethylene glycol-treated wood. The ethylene glycol plasticizes both the SCWL and CCML.

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