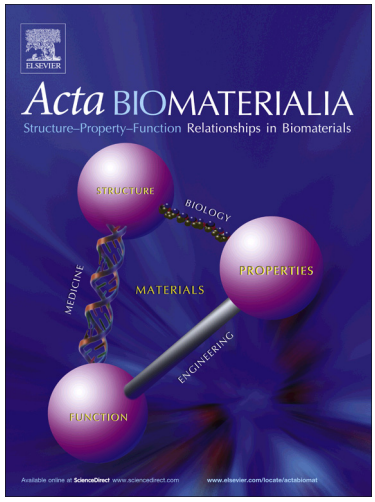

Full length article

3D printed structures for modeling the Young's modulus of bamboo parenchyma

P.G. Dixon, J.T. Muth, X. Xiao, M.A. Skylar-Scott, J.A. Lewis, L.J. Gibson

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3D printed structures for modeling the Young's modulus of bamboo parenchyma

PG Dixon[a], JT Muth[b,c], X Xiao[d], MA Skylar-Scott[b,c], JA Lewis[b,c] and LJ Gibson[a]

[a]Department of Materials Science and Engineering
MIT
Cambridge MA 02139

[b]John A. Paulson School of Engineering and Applied Science
Harvard University
Cambridge MA 02138

[c]Wyss Institute for Biologically Inspired Engineering
Harvard University
Boston MA 02115

[d]Advanced Photon Source
Argonne National Laboratory
Lemont, IL 60439

Abstract

Bamboo is a sustainable, lightweight material that is widely used in structural applications. To fully develop micromechanical models for plants, such as bamboo, the mechanical properties of each individual type of tissue are needed. However, separating individual tissues and testing them mechanically is challenging. Here, we report an alternative approach in which micro X-ray computed tomography (μ-CT) is used to image moso bamboo (*Phyllostachys pubescens*). The acquired images, which correspond to the 3D structure of the parenchyma, are then transformed into physical, albeit larger scale, structures by 3D printing, and their mechanical properties are characterized. The normalized longitudinal Young's moduli of the fabricated structures depend on relative density raised to a power between 2 and 3, suggesting that elastic deformation of the parenchyma cellular structure involves considerable cell wall bending. The mechanical behavior of other biological tissues may also be elucidated using this approach.

Keywords: bamboo, parenchyma, micro X-ray computed tomography, 3D printing

Statement of Significance: Bamboo is a lightweight, sustainable engineering material widely used in structural applications. By combining micro X-ray computed tomography and 3D printing, we have produced bamboo parenchyma mimics and characterized their stiffness. Using this approach, we gained insight into bamboo parenchyma tissue mechanics, specifically the cellular geometry's role in longitudinal elasticity.