MWP – Young Researcher Abstract 2023

Project title: Rationally Designed Strong and Compressible Wood Foam	
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Abstract (approx. 200 words)**:**

Aerogels, foams, and sponges are versatile substrates with a wide range of applications in catalysis, insulation, water purification, and sensing. With the need to replace fossil-based materials with more sustainable solutions, the finely tuned hierarchical structure of wood can provide inspiration and design opportunities for highly porous materials that offer superior mechanical performances and intrinsic lower environmental impact compared to their inorganic counterpart

Herein, the orthotropic structure of wood was modified to obtain wood foams of unique microstructure. In-situ lignin sulfonation followed by freeze-casting of Scots pine created 100-nm scale cell wall porosity that strongly enhanced the permeability and surface area of wood. By preserving the native cellular arrangement and a high ratio of lignin and hemicellulose, the wood foams retained remarkably high strength compared to previously reported cellulose-based foams. In combination with the conductive polymer PEDOT:PSS, the wood foam showed uniform conductivity of 215 S m^{-1}, sponge-like compressibility, as well as reproducible modulation of resistance both at high and low strains. The results suggest that this type of bio-derived material could be further tuned into pressure-responding devices and strain sensors, where both sensitivity and durability are required.

Key words:
wood foam, unidirectional freezing, lignin sulfonation, PEDOT:PSS, conductivity, pressure sensing