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Press release **Defence on 2 June 2021**

Preserving nature with natural materials

Title of the doctoral thesis	Lignocellulosic building blocks for aerogel and nanocomposite applications
Content of the doctoral thesis	Muhammad Farooq's dissertation attempts to address the current environmental challenges stemming from the plastic waste by using plant based alternative materials. Combining the knowledge of biomaterial science and nanotechnology, wood is availed as a platform to obtain different material components such as, cellulose in the form of nanofibrillated cellulose (CNF) and lignin as colloidal lignin particles (CLPs). The potential of both CNF and CLPs in diverse applications is demonstrated and related to their nano-scale morphologies and interesting surface features. The low thermal conductivity of the CNF is used for insulation applications by preparing CNF aerogels. Flame-retardancy is introduced into the CNF aerogels using sodium bicarbonate (SBC) as a natural flame-retardant. The bio-based origin and competitive thermal conductivity values of the prepared aerogels presents a greener solution to building insulations. For efficiently developing applications from colloidal lignin particles, their fundamental interfacial properties and adsorption behavior are studied by combining surface sensitive methods such as QCM-D and AFM. The obtained knowledge is put forth to develop strong nanocomposites from CNF and CLPs. The combination of CNF and CLP at an optimum ratio displays a significant increase in the toughness of the prepared nanocomposite films. For many applications water resistance is an absolute requirement, however there is a need to develop simple, method to prepare hydrophobic nanocomposite films. Reach this goal, a relatively small amount of water-based Polyurethane (PU) is combined with CNF to selectively hydrophobized one side of the nanocomposite film, retaining the hydrophilicity of the other side. To further utilize the large surface area and anionic surface character of CLPs, efficient microreactors are designed for ester synthesis in aqueous media. Prepared enzyme immobilized c-CLPs microreactors displays excellent stability under esterification conditions, reusability, and high molar yield of esterification reaction yield. In conclusion, it is demonstrated that nano-size of CNF and CLPs hold tremendous potential as a material platform to design green products of biological-origin, which will not only benefit the environment but will also contribute to the circular economy.
Field of the doctoral thesis	Bioproduct Technology
Doctoral candidate and contact information	M.Sc. in Polymer Science Muhammad Farooq muhammad.farooq@aalto.fi
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Remote defence	https://aalto.zoom.us/j/65088901067
Opponent(s)	Professor Lennart Bergström, Stockholm University, Sweden
Custos	Professor Monika Österberg, Aalto University School of Chemical Engineering

Dissertation will be on public display at https://aaltodoc.aalto.fi/doc_public/eonly/riiputus