Smart Materials Based on Cellulose Nanocrystals

Dr. Johan Foster's research focuses on cellulose nanocrystals (CNCs) with a high aspect ratio and mechanically stiff fibers that can serve as both a biorenewable reinforcing agent in nanocomposites, as well as a handle for adding stimuli responsiveness. His experimental research is focused on the fabrication and design of photoresponsive cellulose nanofibers that can act as a photoswitchable gelator or as an adaptive filler within a soft polymer matrix. He has attached photoactive moieties to the surface of cellulose nanocrystals and has induced both irreversible and reversible mechanical changes that can be optically induced by altering interactions between said nanocrystals.

Among the many other possible applications he sees for such smart materials is the use of chemically responsive nanocomposites, comprised of polymer matrices and cellulose nanocrystals, as mechanically adaptive substrates for intracortical microelectrodes. Herein, the fabrication of a new generation of stimuli-responsive, mechanically adaptive materials by facile solution casting of a polymer matrix reinforced with CNCs significantly enhanced the mechanical properties of the matrix. Also, these materials showed modest swelling and reversible modulus reduction upon immersion in physiological conditions. These smart materials exhibit properties which are useful for the development of a new generation of mechanically adaptive cortical implants.

ABOUT THE SPEAKER

Dr. Johan Foster focuses on advanced functional and supramolecular bio(nano)materials: design, synthesis, and engineering of bioinspired, biosourced functional polymers, supramolecular materials, and nanocomposites; stimuli-responsive materials; and biomedical materials; and has combined covalent and noncovalent interactions to create structured smart materials. Dr. Foster is a new Associate Professor in Virginia Tech's Materials Science and Engineering Department and a new member of Virginia Tech's Macromolecules and Interfaces Institute. He previously led a group of 8-12 researchers (Ph.D. students and post-docs) at the Adolphe Merkle Institute (AMI) in Switzerland, who focused on cellulose nanocrystals, smart oddslot materials, nanocomposites, synthesis, functionalization, and biomedical implants. He came to Virginia Tech after doing a post-doctoral fellowship with Bert Meijer at Technical University Eindhoven, in The Netherlands, and a Ph.D. at Simon Fraser University in Canada.

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2-4 pm, 310 Kelly Hall

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