KTH SOLID MECHANICS SEMINAR; Thursday, February 24h, 16.15; https://kth-se.zoom.us/j/64275021400

Fredrik Lundell

"Preparation of nanostructured biomaterials with good mechanical properties and novel functions"

Strong and stiff cellulose filaments (Young's modulus up to 86 GPa; tensile strength 1,5 GPa) can be prepared by hydrodynamic assembly, where a flow is used to create a "gel-thread" of aligned cellulose nanofibrils (CNF). After drying of this thread, a filament is obtained. This is a special case of assembly, and in general, the nanostructure, primarily particle orientation, controls mechanical and functional properties when macroscopic materials are assembled from nanofibrils. Understanding and controlling the nanostructure is therefore an important key for the continued development of nanostructured materials. We merge recent developments in the assembly of biological nanofibrils, X-ray diffraction orientation measurements, and computational fluid dynamics of complex flows. The result is a digital twin, which reveals the complete particle orientation in complex and transient flow situations, in particular the local alignment and spatial variation of the orientation distributions of different length fractions, both along the process and over a specific cross section. The methodology forms a necessary foundation for analysis and optimization of preparation processes for macroscopic materials from anisotropic particles. Furthermore, it provides a bridge between advanced in operandi measurements of nanostructures and phenomena such as transitions between liquid crystal states and in silico studies of particle interactions and agglomeration.

Fredrik Lundell is professor in experimental fluid mechanics at KTH Engineering Mechanics since 2018. He has a master in Engineering Physics (1998) and PhD in Fluid Mechanics (2003), both from KTH. After his PhD, he spent a year as a postdoc at CEA, Commissariat à l`Énergie Atomique et aux Énergies Alternatives, in Grenoble, France. After the postdoc, he returned to KTH and had positions as a researcher (EU, 2004-2006), research associate (VR, 2007-2010) and associate professor (2010-2018). His research interests have been laminar/turbulent transition, boiling, particle suspensions, wetting and hydrodynamics for assembly of novel biobased materials. He was responsible for the Vehicle Engineering program 2012-2016, director of the Odqvist Laboratory 2016-2017 and head of the unit for higher education research and development 2018-2019. Since 2020, he is head of the department of engineering mechanics. He was co-funder, co-chair and chair of the European Research Community (ERCOFTAC) special interest group on fibre suspension flows 2008-2019 and a member of the Swedish Paper and Cellulose Engineers Association's (SPCI's) research committee 2016-2020.