Talk 1

Relationships Between Nanostructure and Mechanical Properties of Nanocellulose Composites - a Renewable Material with Properties of High Potential

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Abstract

Cellulose is the most abundantly available polymer on the planet. It is renewable and has remarkable theoretical mechanical properties considering the simple chemical building blocks, e.g. a stiffness of about 150 GPa. In processed cellulose material, such as paper, board, composites etc., the mechanical properties are not so impressive. The last few years have seen intensive world-wide research on the chemistry and processing of nanocomposites based on cellulose with the aim of attaining the potentially high mechanical properties. Less research has been made on the quantitative understanding and modelling of nanostructure-property relations. The aim of this presentation is to show the recent developments in making cellulose nanocomposites with respectable mechanical performance and some obstacles for future research, such as upscaling from the laboratory to the industrial scale, the inevitable moisture effects which cause swelling and degradation of the stiffness and strength, as well as the concomitant difficulties in dispersing the nanofibrils. A review of modelling work will be made, highlighting the limitations and utility of these in providing help in decision making for rationalized materials design in manufacturing of these nanocomposites. Own recent research results will be presented including applications for soft tissues as artificial skin, stiff cellulose monocomponent nanocomposites, and micromechanics adopted for prediction of elastic and swelling properties of nanocomposites. Attempts are made to identify bottlenecks in useful nanocomposite modelling work, such as input parameters in terms of nanostructure and constituent properties. Emerging techniques how to identify such parameters will also be outlined, in light also of nanocomposites made from other components.

Talk 2

Educational, academic and industrial structures in Sweden - A perspective from the Department of Engineering Sciences of Uppsala University

Abstract

This informal presentation will give a glimpse of university and related industrial activities in Sweden. The general educational system will be presented, and then zooming on local education at the Department of Engineering Sciences at Uppsala University. Both positive and negative features are to be identified. Next, the research system is outlined, starting with a European perspective, then narrowing down to Sweden and the local level. The benefits of transnational industrial/academic collaboration sponsored by the European Union are also mentioned. In this context, international collaboration has shown to boost the quality of the local research. The role of industrial activities and controlling research orientation is also touched on. Targeted and applied research to help national industries is more easily funded than basic research. Some key manufacturing companies in Sweden include Volvo, Scania, ABB, Sandvik, Atlas Copco, Stora, etc. Finally some cultural and general aspects of life in Sweden will also be mentioned.

Short Biograhy

Kristofer Gamstedt holds the chair in Applied Mechanics at Uppsala University, Sweden since 2011. He received his PhD in Polymer Engineering from Luleå University of Technology, Sweden, in 1998 on the topic of fatigue in polymer matrix composites. Subsequently, he worked as post-doc for three years at the Risø National Laboratory (presently part of the Technical University of Denmark) on mechanics of composites used in wind turbines. From 2001 to 2010, he held positions as assistant and associate professor at KTH, the Royal Institute of Technology in Stockholm. His research activities were then devoted renewable cellulose based composite materials, including nanocomposites reinforced by nanofibrillated cellulose. Since becoming full professor in 2011 at Uppsala University, he continues his research on nanocomposites based on cellulose, among other materials such as natural wood, which shows a hierarchical structure down to the molecular level with unexpected mechanical performance considering the basic molecular building blocks. His research on nanostructured materials leans on both experimental investigations and modelling to relating the material structure to the mechanical properties, aiming to rationalized materials development and design.