SPEAKER

NAME
Professor Lars Wågberg

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BIOGRAPHY

1. Year of birth
   1956
2. Year of PhD-degree
   1988
3. Current position (Swedish term)
   Professor, KTH, Fibre Technology
4. Research interest
   Interaction at thin interfaces and interphases of relevance to fibres, i.e. lignin, cellulose and hemicellulose mainly from wood but also natural fibres and synthetic fibres in general. Colloidal chemical properties of nanocelluloses and adhesion fundamentals between cellulose, hemicellulose and lignin containing materials. Wetting and absorption in porous materials and gels from renewable materials
5. Number of publications in international scientific journals, number of citations, H-index
   403 publications, 8387 citations and H-index 53 in Web of Sci
6. Experience as PhD-student advisor, current role
   Advised and graduated 32 PhDs. Currently leading a group of 25 people in the Fibre Technology division at KTH.
7. Other information primarily for young researchers; grant, prizes, entrepreneur activities etc.
   Around 30 patents including his time in the industry. Spent 12 years in the industry before coming back to academia. Holds the Ekman Medal and is a member of the Royal Academy of Engineering of Sweden and is a Fellow of the Royal Society of Chemistry, England.

LECTURE

Lars Wågberg, Per Larsson and Yunus Can Görür, Fibre and Polymer Technology, KTH Royal Institute of Technology

Strategies for preparing strong and transparent films from cellulose-rich fibres using papermaking methods

The development of nanocelluloses (NCs), both in the form of Cellulose NanoFibrils (CNFs) and Cellulose NanoCrystals (CNCs), has created an opportunity for using bottom-up engineering for cellulose-based materials. By using combinations of NCs and other types of nanomaterials or tailored polymers it has been possible to prepare strong and durable composites as well as interactive devices just to mention a few examples. Since the preparation of nanocelluloses and their post-processing can be performed in aqueous dispersions they are also very attractive from an environmental point of view. However, due to their high aspect ratio, which is indeed also one of their main advantages, the NCs can only be handled in rather dilute dispersions and the subsequent water removal has been and is a major obstacle in the up-scaling of processes including the NCs.

One appealing alternative to using the liberated NCs is to functionalize the fibrils or fibril aggregates in the macroscopic cellulose-rich fibres while still keeping their overall fibre structure and to prepare papers from these fibres that then can be treated in a subsequent treatment step to develop the built-in properties of fibrils. Two examples of this will be demonstrated where the prepared papers can be converted to transparent films with good mechanical and barrier properties. In the first example the cellulose-rich fibres were first oxidized with $NaIO_4$ and then reduced with $NaBH_4$ to partially convert the cellulose within the fibres to di-alcohol cellulose. This treatment will create fibres which have thermoplastic properties. The second approach is a further development of this first approach where a combination of TEMPO oxidation and a subsequent $NaIO_4$ treatment was used to prepare fibres that could be easily disintegrated by simply increasing the pH from around pH= 4 to pH=10. Papers can easily be formed from these modified fibres, using either of these two pre-treatments, using conventional paper forming methods and the so formed papers could then be used to prepare strong films with very good barrier properties either by heating or a simple pH modification procedure of the formed papers. In this way it is hence possible to utilize the lessons learned with NCs and to simultaneously use conventional papermaking procedures which allow for a rapid up-scaling of these new materials.