Institut für Physik

Montanuniversität Leoben

A-8700 LEOBEN, Franz Josef Straße 18, Austria
Tel: +43 3842 402-4601, Fax:+43 3842 402-4602
e-mail: physics@unileoben.ac.at

S E M I N A R
aus
Halbleiterphysik und Nanotechnologie

Mo, 11.3.2019, 11:15 Uhr, Hörsaal für Physik

"Wood – hierarchical, porous and eco-friendly fibers for multifunctional bio-composites"

Lars Berglund

Wallenberg Wood Sci Ctr, Dept of Fiber and Polymer Technology, KTH Royal Inst of Technology, Stockholm, Sweden

Polymer composite materials are widely used in the form of glass fiber or carbon fiber composites for applications in automotive, aerospace or sports industry. Industrial cellulose bio-composites, were often based on saw-mill waste mixed with recycled thermoplastics and considered as cheap replacement materials for virgin plastics. Recently, this view is beginning to change. The role of plastics in carbon dioxide emissions and global warming is becoming recognized, as well as in packaging waste and the problems of plastics in the oceans.

There is now an opportunity for new cellulose bio-composites products where mechanical properties are combined with new functions, and possibly new processing strategies where recycling and reuse is designed into the materials from the beginning.

Wood can serve as a starting point. This highly porous material can actually be designed so that it combines optical transmittance with high mechanical performance. This raises interesting questions about the basic structure and properties of wood fibers; which may have been underestimated in the past. Young's modulus may actually approach the values for glass fibers although the density is much lower than for glass. The wood cell wall is a nanostructured, and nano-porous material, with ample opportunity for modification and functionalization. High-resolution analysis of the dynamics of polymer mobility are provided, where it is demonstrated that cellulose is highly complex. This is particularly true with respect to moisture dynamics. A refined understanding of the wood cell wall is resulting, which perhaps can be exploited in the future. Solid state NMR relaxometry data correlates with MD simulations of specific cellulose structures in the wood cell wall.

Examples of interesting wood bio-composites show luminescence, lasing, exceptional mechanical properties combined with high optical transmittance, recyclability, fire retardancy as well as specific nanostructures with unique mechanical behavior.

LA Berglund, I Burgert, Bioinspired wood nanotechnology for functional materials, Adv Materials, 30, Art No 1704285, 2018