SPEAKER

NAME

Prof. Dr. Andreas Walther

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BIOGRAPHY

Andreas Walther is a Professor for Functional Polymers at the Institute for Macromolecular Chemistry at the Albert-Ludwigs-University in Freiburg (Germany). His research interests concentrate on developing and understanding hierarchical self-assembly concepts inside and outside equilibrium, and on using them to create Active, Adaptive and Autonomous Bioinspired Material Systems - A3BMS.

He graduated from Bayreuth University in Germany in 2008 with a Ph.D. on Janus particles and pursued postdoctoral studies with a focus on biomimetic hybrid materials at Aalto University (Helsinki, Finland). After establishing his independent research group at the DWI – Leibniz Institute for Interactive Materials in Aachen in 2011, he was appointed to his present position in Freiburg in 2016.

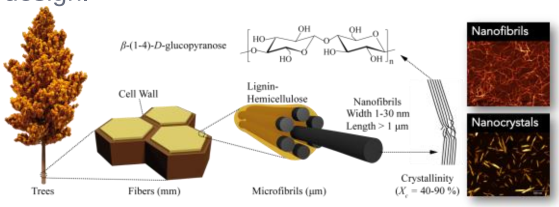
A. Walther has published ca. 140 papers (h-index 54) and has recently been awarded the Bayer Early Excellence in Science Award (for Materials), the Reimund Stadler Young Investigator Award of the German Chemical Society, a BMBF NanoMatFutur Research Group, an ERC Starting Grant, as well as the Hanwha-Total IUPAC Young Scientist Award awarded at the biannual IUPAC World Polymer Congress 2018.

He is a fellow of both the Freiburg (FRIAS) as well as the Strasbourg Institute for Advanced Studies, and a founding PI and board member of the DFG livMatS Cluster of Excellence on “Living, Adaptive and Energy-Autonomous Materials Systems”.

LECTURE

Understanding the mechanical performance of Nanocellulose, Nanopapers and bioinspired Nanocomposites

Cellulose and chitin nanofibrils (CNF, ChNF) as well as nanocrystals (CNCs) are emerging building blocks for advanced functional materials due their nanoscale dimensions, high crystallinity and excellent mechanical properties. Key aspects in translating their intriguing properties into high performance and functional materials are to manage their organization into higher level structures and exploit the differences in their chemical composition to an advantage in materials design.



In this talk I will first discuss in detail how highest-performance self-assembling bioinspired nanocomposites, i.e. wood-inspired nanopapers and crustacean-inspired nanocomposites can be prepared by exploiting our concept of polymer-coated hard/soft nanoparticles to prepare highly ordered structures at high fractions of reinforcements. I will discuss how engineering of thermomechanical properties of the tailor-made polymers need controls toughness, and how the implementation of supramolecular reversible bonds can be used for implementing sacrificial bonds. In the case of CNCs, single step assembly of tunable photonic reflectors complement the design of the mechanical property space in the direction of multifunctional material classes. Additionally, the merger of this bottom-up structuring with top-down 3D printing enables the preparation of mechanical gradient materials that can even be reprogrammed in a light-adaptive manner.

Secondly, I will showcase how 3D printing approaches can be used to make scaffolds materials for bone tissue regeneration and how 3D printed tubes can be used as sacrificial templates for free-standing tissue constructs using mild enzymatic degradation of the CNF after cell growth.

I will conclude the talk by demonstrating critical advantages of nanochitin-based materials over nanocellulose-based ones in the context of fire-retardant and fire barrier materials.