Technology Offer

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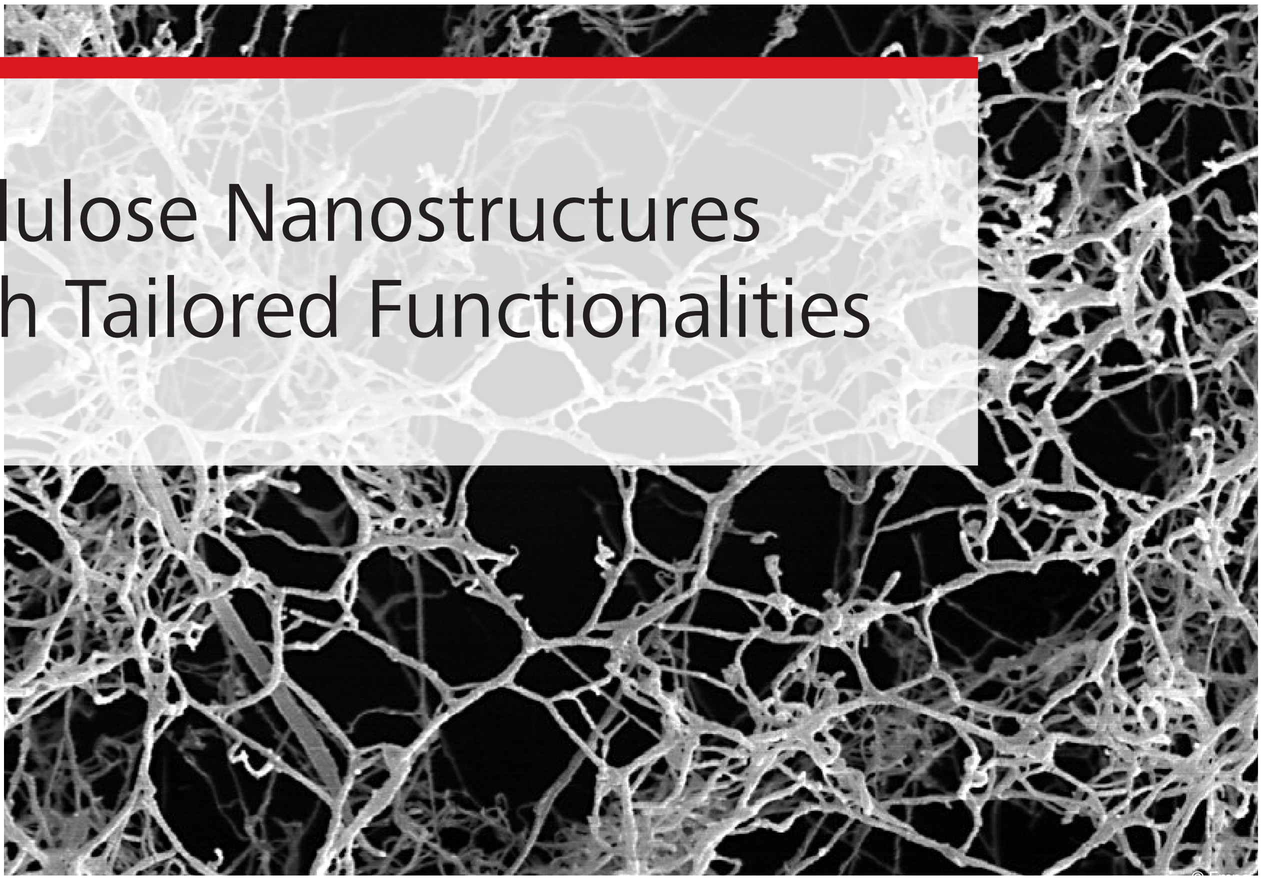
Cellulose Nanostructures with Tailored Functionalities



Nanofibrillated Cellulose from wood pulp

Invention

The invention addresses the preparation of functional silylated nanofibrillated cellulose (NFC) using a universal chemical procedure suitable for the implementation on large-scale. Commercially available alkoxysilanes known as adhesion promoter and/or coupling agents are used. The polarity or reactivity of the NFC can be tailored by the organofunctional group X which can be a reactive or compatibility group.

Background

For an optimal compounding of NFC with different (bio)polymers, good fibril/matrix compatibilization is required. A major problem concerning the compounding is the bad adhesion of hydrophilic NFC to hydrophobic polymer matrices. A poor dispersion respectively agglomeration of NFC in the polymer matrix is a consequence thereof, leading to poor mechanical properties of the resulting composite. To prevent this, the surface of NFC has to be modified accordingly in order to promote adhesion. A strong adhesion at the interface between nanofibrils and polymer matrix can lead to enhanced interaction between the components and a more effective transfer of stress and load distribution within the composite material.

Advantages

The advantages of the silylated NFC derivatives are directly related to the organofunctional group "X" of the silicon, which plays the main role in the adhesion promotion or binding. This group must be chosen carefully to ensure maximum compatibility with the (bio)polymer matrix of interest (Figure 1). If "X" is a "reactive group", the bonding to the polymer matrix takes place by chemical reaction. By choosing X as a compatibility group, the adhesion between NFC and polymer matrix can be achieved by secondary forces. Thus, applying these simple preparation and isolation procedures and using an infrastructure which is available at industrial level, a broad range of silylated NFC with different reactive groups and/or polarities can be synthesized (Figure 2).

Applications

Dry functional NFC materials with different polarities and/or reactivities could be used to improve or tailor properties of polymers for technical applications like: tensile strength, tear strength, stiffness, thermal expansion, biodegradability, transparency, water-retention, moisture resistance, dying, etc. Thus, a broad range of applications such as in coatings, adhesives/sealings (PURs, latex adhesives, silicones), filters, membranes, packaging, transportation, medicine, food or cosmetics are conceivable.

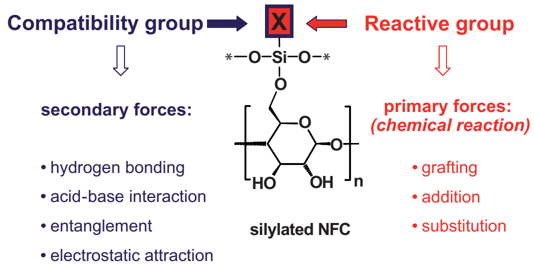


Figure 1
Advantages of functional silylated cellulose nanofibrils: the adhesion (by *secondary forces*) or binding (by *chemical reaction*) of NFC to a certain (bio) polymer matrix can be achieved by properly choosing the organofunctional group X

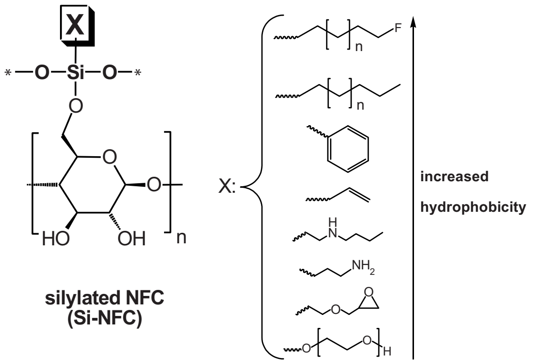


Figure 2
Silane condensation allows the preparation of functional NFC with a broad range of polarities, from hydrophilic to hydrophobic

Ownership

Empa, Swiss Federal Laboratories for Materials Testing and Research,
Überlandstrasse 129, CH-8600 Duebendorf, patent pending

References

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Keywords

nanofibrillated cellulose, NFC, chemical tailoring, alkoxysilanes, silane condensation

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